ASSESSMENT OF NEUROCOGNITIVE, SOCIAL, AND ACADEMIC FUNCTIONING IN STUDENTS WITH NEURODEVELOPMENTAL DISORDERS

A Dissertation

by

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ABSTRACT

Neurodevelopmental disorders has become a topic of interest primarily due to the increased prevalence as well as the educational and social impairments that often accompany these disorders. Children with neurodevelopmental disorders are at-risk for negative long-term outcomes such as difficulties at school, poor peer relationships, strained parent-child relationships, development of comorbid disorders (e.g., mood disorders), and deficits in executive functioning. Increased knowledge and research about these long-term outcomes have called for the creation of intervention and prevention programs; however, the efficacy and effectiveness of most of these programs have either not been established or are limited. Additionally, despite robust literature on the importance of executive functioning, little has been published about systematic interventions that may enable children with executive functioning deficits to develop in this domain of functioning.

The present study examines potential relations between the development of executive function and exposure to a school-based, systematic intervention in students with neurodevelopmental disorders. Participants included students from a therapeutic day school who received systematic interventions related to self-regulation, executive function, social development, and academic competence. Measures of these four core areas were given to teachers and parents to complete regarding students' emotional/behavioral adjustment and academic progress over the course of three academic years. Results indicated that measures of self-regulation account of significant

variance related to the number of years in the program. Additionally, for some measures of social and executive functioning, the program level accounts for significant variance in the results. Additionally, measures of social development and social skills, indicated that across groups, students differed related to social skill deficits. Lastly, the regression analyses suggested that measures administered concurrently were better predictors of outcome measures in areas of emotional/behavioral functioning and academic achievement. Thus, there is some support for the use of systematic interventions for students with executive functioning deficits to impact long-term outcomes in emotional, behavioral, social, and academic areas.

DEDICATION

To my husband Kevin, thank you for your unconditional love and support. To my parents, thank you for teaching me the value of hard work and pushing me to actualize my dreams. To my brother, thank you for always believing in me and reminding me that laughter is life's best medicine.

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CHAPTER I

INTRODUCTION

The prevalence of children and adolescents with neurodevelopmental disorders is rising (Froehlich, Lanphear, Epstein, Barbaresi, Katusic, & Kahn, 2007; Matson & Kozlowski, 2011). Moreover, their neurocognitive profiles, as well as accompanying educational and social impairments, affect the long-term outcome of these individuals. Long-term risk factors for school-age children with neurodevelopmental disorders include difficulties at school, poor peer relationships, strained parent-child relationships, development of comorbid disorders (e.g., mood disorders), and deficits in executive functioning (Larson, Russ, Kahn, & Halfon, 2007; Zablotsky, Bradshaw, Anderson, & Law, 2012). Children with neurodevelopmental disorders are also at a greater risk for poor longer term outcomes such as lower educational and employment attainment (e.g., Abikoff, Gallagher, Wells, Murray, & Huang, 2013; Harpin, 2005; Seidman, 2006).

In particular, increasing numbers of children are being diagnosed with Autism Spectrum Disorders (ASD) and Attention Deficit/ Hyperactivity Disorder (ADHD). ASD and its associated behaviors have been estimated to occur in as many as one in 110 children (Centers for Disease Control and Prevention [CDC], 2012). ASD is four times more prevalent in males and does not appear to be affected by racial, ethnic, or social demographics. Similarly, according to a report released by the CDC (2012), approximately one in 10 school-age children have been diagnosed with ADHD. Boys are more than twice as likely to be diagnosed with ADHD as girls. In terms of peer

relations, children with ADHD and ASD are three times more likely to experience peer problems than those school-age children without a history of these disorders. Parent reports indicate that children with ADHD and ASD are 10 times more likely to have difficulties (e.g., emotional problems, conduct problems) that interfere with friendship development (Lee, Harrington, Louie, & Newschaffer, 2008; Strine et al., 2006). Children with neurodevelopmental disorders appear to have impairments that may affect overall functioning compared to typically developing peers.

Neurocognition: Executive Function

One neurocognitive domain believed to be impaired in many neurodevelopmental disorders is executive function (EF). The construct of executive function has been defined as "the ability to maintain an appropriate problem set for attainment of future goals" (Welsh & Pennington, 1989, p. 201) and includes such abilities of attention, interference control, reasoning, planning, inhibition, set-shifting, and working memory (Danielson, Henry, Messer, & Rönnberg, 2012; Pennington & Ozonoff, 1996). These abilities, which develop over childhood and through adolescence, are seen as vital to a person's ability to succeed in an increasingly more complicated world. In fact, EF have been described as being "at the heart of all socially useful, personally enhancing, constructive, and creative thoughts. Impairment or loss of these functions compromises a person's capacity to maintain an independent, constructively self-serving, and socially productive life." (Lezak, 1982, p. 281). EF are considered imperative for complex human behavior; the breakdown of EF is thought to manifest in

psychological or behavioral impairment (Biederman, Petty, Doyle, Spencer, & Henderson, 2008; Goldberg & Seidman, 1998).

EF deficits directly affect educational and social/behavioral functioning across development. Children with EF deficits may fail to adequately develop the requisite abilities to interact productively within their environment (Marlowe, 2000). In childhood, they often demonstrate a wide range of cognitive, academic, and social disorders. In adolescence and adulthood, they may encounter greater difficulty living independently due to EF deficits (Anderson, Bechara, Damasio, Tranel, & Damasio, 1999; Diamantopoulou, Rydell, Thorell, & Bohlin, 2007; Kofler et al., 2011). Given the critical importance of EF for adequate development, it is important to consider the poor long-term psychological, academic, and social outcomes associated with disorders that are characterized by executive dysfunction such as ADHD (Barkley, 2006; Pennington & Ozonoff, 1996; Gau & Chiang, 2013) and ASD (Losh, Adolphs, Poe, Couture, & Penn, 2009; Ozonoff, 1998; Sigman, Spence, & Wang, 2006). Additionally, lower level language and academic related skills (Carcani-Rathwell, Rabe-Hasketh, & Santosh, 2006; Dadds, Schwartz, Adams, & Rose, 1988) and lower academic achievement, as measured by either standardized measures or school placement, have been associated with EF deficits (e.g., Alloway, Gathercole, & Elliott, 2010; Sarver et al., 2012). The academic and social difficulties associated with having ASD, ADHD, or any other neurodevelopmental disorder likely result from the underlying EF deficits.

EF and ADHD

Substantial work has indicated that ADHD in children is associated with EF deficits as compared to typically developing children (e.g., Martel, Nikolas, & Nigg, 2007; Willcutt et al., 2005). Toplak, Bucciarelli, Jain, and Tannock (2009) investigated the performance of students with ADHD and students in a control group on performance-based measures of executive function, as well as parent and teacher ratings. They found that students with ADHD performed significantly more poorly on performance-based measures, and parents and teachers endorsed significantly more concerns with executive function than those of the control group. Specifically, research has indicated that children with ADHD often demonstrate adverse effects such as poor academic achievement and diminished social skill development as a result of EF deficits (e.g., Miller & Hinshaw, 2010; Volpe et al., 2006). There is a body of research that supports the idea that EF deficits underlie both academic and social outcomes.

Currently it is estimated that about one-half of children with ADHD have been identified as having an academic disability (CDC, 2010). Academic concerns for children with ADHD commonly include poor grades, increased grade retention, and poor math and reading standardized test scores. ADHD is also associated with increased rates of detention and expulsion, increased use of school-based services, and low rates of high school graduation and pursuit of postsecondary education (e.g., Abikoff, Gallagher, Wells, Murray, & Huang, 2013; Barkley & Fischer, 2011; Loe & Feldman, 2007; Power, Werba, Watkins, Angelucci, & Eiraldi, 2006).

It is also suggested that children with ADHD often present with concerns related to social skill development (Harpin, 2005). In addition to educational and vocational impairments, it is also suggested that children with ADHD present with concerns related to social and relationship development. ADHD has a distinguishable effect on social functioning (Barkley, 2006). Those with ADHD have fewer friends, decreased self-esteem, and struggle to maintain peer relationships they do have. Peers without ADHD often find the impulsive and hyperactive behaviors of children with ADHD to be undesirable and these behaviors act as a repellent to peers (Di Pinto, 2006). This deficit in social functioning also reaches across contexts. Children with ADHD have poorer relationships with peers, parents, teachers, and employers (Greydanus, Pratt, & Patel, 2007).

ASD and EF

Similarly to children with ADHD, those with ASD present with EF deficits that are related to academic and social impairments. Research has consistently shown that children with ASD demonstrate impairment in EF in comparison to normally developing peers (e.g., Russo et al., 2007; Sachse, Schlitt, Hainz, Ciaramidaro, & Schirman, 2013; Schurink, Hartman, Scherder, Houwen, & Visscher, 2012; Verte et al., 2006) and this has been identified as an important area of study in relation to ASD. Specific impairments in children with ASD have been demonstrated in set shifting (i.e., moving between multiple pieces of information) and cognitive flexibility (i.e., the ability to use different problem solving techniques and recognize more than one solution to a problem; Ozonoff & Jensen, 1999; Joseph, 1999; Russo et al., 2007; Verte et al., 2006). In

addition, there is evidence for impairments in the domain of working memory (i.e., holding information in active memory in order for further processing or integration) and behavior inhibition (e.g., Russo et al, 2007; Rogers & Bennetto, 2000; Verte et al, 2006).

Numerous components of EF have been found to be linked to performance in academics in children with ASD. Specifically, behavioral inhibition and working memory have been linked to English and math achievement in school-age children with ASD (Espy, McDiarmid, Cwik, Stalets, Hamby, & Senn, 2004; St. Clair-Thompson & Gathercole, 2006). Lower level language and academic related skills (Carcani-Rathwell, Rabe-Hasketh, & Santosh, 2006) and lower academic achievement outcomes, as measured by either standardized measures or school placement, have been found for students with ASD (Power, Werba, Watkins, Angelucci, & Eiraldi, 2006).

In addition to lower educational outcomes, children with ASD are characterized by several core deficits including social skills impairments and difficulty processing social information (e.g., Russo et al., 2007; Verte et al., 2006). Children with ASD have difficulty with higher order mental organization and planning, as well as with processing multiple levels of information (i.e., EF difficulties), which likely affects their ability to successfully interact socially with others (Solomon, Goodlin-Jones, & Anders, 2004). Additionally, EF deficits are associated with lower adaptive behavior scores among children with ASD (Baddeley, 2003; Mayo, Chlebowski, Fein, & Eigsti, 2013; Szatmari et al., 2006; Venter, Lord, & Schopler, 1992). The combined EF, academic, and social deficits constitute major concerns that warrant intervention.

Intervention Programs for Children with Neurodevelopmental Disorders

Given the larger numbers of children being diagnosed with disorders like ADHD and ASD, there has been increased development of intervention programs to address neurocognitive deficits and ultimately improve the outcomes for children with neurodevelopmental disorders. Although EF deficits are implicated in many neurodevelopmental disorders, it is not clear that all the approaches address these EF deficits. Some of the available programs include the Montessori approach, the TEACCH program for ASD, the Girls and Boys Town Education Model (GBTEM), Applied Behavior Analysis (ABA), and the program of The Monarch School (TMS). Of these, the TMS program is designed with EF as a core skill group, yet there is limited research available on this program.

The Monarch School

The Monarch School (TMS) incorporates a combination of approaches within a framework that is learner-centered. TMS is a therapeutic day school serving students who have a wide variety of neurological and psychiatric diagnoses including those with ASD, ADHD, or any other neurodevelopmental disorder (e.g., seizure disorder, mood disorder). The curriculum of TMS is designed to address each student's ownership of skills in four core goal areas: (a) self-awareness and self- regulation; (b) social development; (c) EF; and (d) academic competence. These core goal areas include fundamental elements of development that are defining features of EF (i.e., inhibit, shift, emotional control, initiate, working memory, plan/organize, organization of materials,

and monitor; Gioia, Isquith, Guy & Kenworthy, 2000; Loe & Feldman, 2007; Ylvisaker & Feeney, 2002). For students, these core elements form the foundation of a collection of strategies useful for life-long success as learners and problem solvers (Raskind, Goldberg, Higgins, & Herman, 1999).

What research is available suggests that the TMS model improves skills related to EF, specifically inhibition, shifting, and emotional control (Hall, 2007). For students with ASD, research also indicated that attendance at a therapeutic day school often mobilize additional resources with families more united as a result (Bayat, 2007). Several studies suggested that students, regardless of diagnosis, can improve peer interactions through teaching peer initiations and allowing students to positively interact with other students with neurodevelopmental disorders (Krantz & McClannahan, 1993; Sarokoff, Taylor, & Poulson, 2001) as occurs as part of the TMS program. There is, however, minimal research available on the effectiveness of the combination of approaches in facilitating EF development, or in predicting academic or social outcome, or the usefulness of the measures currently used for program monitoring.

Statement of the Problem and Purpose of the Study

Despite the growing literature on the importance of EF, little has been written about systematic interventions that may enable children with EF deficits to develop in this domain of functioning (Marlowe, 2000). The purpose of this study is to further examine the TMS objectives-based curriculum in relation to the development of EF skills in students with neurodevelopmental disorders, including ASD and ADHD, as well as anxiety, mood disorders, and Tourette syndrome. The current study will examine

parent and teacher recorded data of several measures of EF for students in TMS over a 4 year period to address specific research questions.

The research questions to be addressed are as follows:

1) What is the relation between the results on measures used to represent the four core goals of the TMS program (self-regulation, executive function, social development, academic competence) as measured by parent and teacher Metacognitive Index (MI) and Behavior Regulation Index (BRI) of the Behavior Rating Inventory of Executive Function (BRIEF), Executive Function (EF), Developmental Social Disorders (DSD) content scales and Study Skills (StS) and Learning Problems-Teacher Form (LP) of the BASC-2, and Social Skills (SS) and Academic Competence (AC) scales of the SSIS? It was hypothesized that results the BRIEF, SSIS, and BASC-2 scales would be interrelated with strongest correlations between scales measuring the same constructs, or core goal. It was hypothesized that parent and teacher ratings will be moderately correlated by scale.
2) To what extent do parent and teacher ratings of Metacognitive Index, Behavior Regulation Index (BRIEF), Executive Function and Social Developmental Disorder content scales (BASC-2), and Social Skills and Academic Competence scales (SSIS) vary across time points? It was hypothesized that teacher and parent ratings will vary across time points for all measures.

3) Do the students at differing levels (Novice/Apprentice, Challenger/Voyager) differ on current measures of functioning across measures representing the four core goals and outcomes? It was hypothesized that children will differ significantly by level in terms of behavioral regulation, metacognitive skills, social interaction skills, and academic competence, as well as executive function and social development. Specifically, it was hypothesized that children in the Novice/Apprentice level would evidence more deficits in core domains as compared to those in the Voyager/Challenger level.
4) For the 2013-2014 data, which of the components as measured by the Teacher BRIEF, BASC-2, and SSIS (i.e., metacognition, behavior regulation, executive functioning, social skills, academic competence, social development) account for significant variance in academic achievement as measured by the Group Mathematics Assessment and Diagnostic Evaluation (GMADE) and Group Reading Assessment and Diagnostic Evaluation (GRADE)? Which components account for significant variance in emotional/behavioral adjustment as measured by the BASC-2 Behavior Symptom Index (BSI) and Adaptive Skills (AS) Composite? It was hypothesized that the Metacognition Index (MI) and the Study Skills (StS) Scale will account for the greatest variance in academic achievement as measured by the GMADE and GRADE. It was hypothesized that the Behavioral Regulation Index (BRI) and Executive Function (EF) Content Scale will account for the greatest variance in emotional and behavioral

adjustment as measured by the BASC-2 BSI and Adaptive Skills (AS) Composite.

5) Is academic achievement predicted better by the results of the BRIEF, BASC-2, and SSIS completed concurrently or can achievement be predicted by scores on these measures from earlier years (i.e., results from 1-2 years before)? Are concurrent or earlier scores predictive of emotional and behavioral outcomes? It washypothesized that outcome variables for academic achievement and emotional/behavioral outcomes are better predicted by concurrent results as opposed to earlier results.

Implications and Significance

Marlowe (2000) reported that despite increased literature on developmental executive disorders, little is written about interventions designed to aid students in the systematic acquisition of skills that will increase EF. The research proposed will provide additional information about the intervention program at TMS that was designed to address the development of EF in students with neurodevelopmental disorders. Further information on the program being implemented at TMS will add to the knowledge base in relation to this program as there is little research available. Descriptive information by level of the program will provide information on how the two major levels differ from each other, as well as to provide a more comprehensive picture of the students at TMS. Moreover, results may provide an objective component to the process of determining placement for students in the program and for future program modification and evaluation. Examining the overlap in what instruments

measure, as well as what unique information is generated by the measures used, can help in the decision-making regarding the data to be gathered as part of the decision-making process with individual students in the future. Finally, this will be the first study to examine the relation between the four core components of the curriculum with academic achievement and overall adjustment.

CHAPTER II

LITERATURE REVIEW

The incidence of children and adolescents with neurodevelopmental disorders is increasing. The neurocognitive profiles for these individuals, as well as specific impairments related to educational and social functioning, impact long-term outcome for these children and adolescents. Long-term risk factors for school-age children with neurodevelopmental disorders include difficulties at school, poor peer relationships, strained parent-child relationships, development of comorbid disorders (e.g., mood disorders), and deficits in EF (Larson, Russ, Kahn, & Halfon, 2007; Zablotsky, Bradshaw, Anderson, & Law, 2012).

Of particular note among neurodevelopmental disorders, children are being diagnosed with neurodevelopmental disorders such as Autism Spectrum Disorders (ASD) and Attention Deficit/ Hyperactivity Disorder (ADHD) at higher rates than previously. It is estimated that one in 110 children present with ASD and its associated behaviors (Center for Disease Control and Prevention [CDC], 2012). Similarly, according to a report released by the CDC (2012), one in 10 school-age children have a diagnosis of ADHD. There is an extensive research base devoted to these two disorders given their prevalence and impact on general functioning in children. One of the most significant cognitive accounts of ASD and ADHD in recent years theorizes that the social and non-social difficulties (e.g., academic difficulties) may come from deficits in EF (Happe, Booth, Charlton, & Hughes, 2006; Hill, 2004; Ozonoff, 1998).

Executive Function

EF is a neurocognitive domain that is believed to be impaired in children and adolescents with many neurodevelopmental disorders, including but not limited to ADHD and ASD. The construct of EF is somewhat ambiguous, cut generally includes those cognitive processes (i.e., attention, reasoning, planning, inhibition, interference control, working memory) that underlie goal-directed behavior and are coordinated by activity within the prefrontal cortex (e.g., Best & Miller, 2010; Olson & Luciana, 2008). Definitions of EF hinge on the classic distinction between automatic and effortful processing. While the automatic processing provides an efficient means of responding to routine situations, the effortful processing is required for adaptive responses to novel or complex situations and involves a range of higher-order cognitive processes such as set-shifting, inhibition of prepotent responses, self-monitoring, and planning (Happe, Booth, Charlton, & Hughes, 2006; Pennington & Ozonoff, 1996).

Embedded within EF is metacognition or the ability to think about and monitor one's own cognitive processes. Metacognition includes the ability to plan, organize, and problem-solve, as well as working memory (Gioia, Isquith, Kenworthy, & Barton, 2002). Learning often involves exploiting metacognitive strategies for the purpose of self-management and for deciding how to engage in learning behavior during a learning task. Additionally, aspects of metacognition such as planning and organizing are important when a student is deciding what to study and how to concentrate and self-manage (Zhang & Maruno, 2010). Zhang and Maruno (2010) found that students' pursuit of academic goals was positively correlated to metacognition and motivation.

Poissant (2004) suggested that children with neurodevelopmental disorders demonstrate a delay in metacognitive development compared to healthy controls. The author discussed the general pattern of the emergence of self-control and internalized language as occurring around the age of 4. During this time, a typically developing child is thought to develop the ability to delay a response and maintain active thought, allowing for more efficient learning and organization (Poissant, 2004). In contrast, children with ADHD or ASD show delays in metacognitive development and demonstrate an impaired ability to use internal feedback and conscious self-monitoring to control their own cognitive processes (Bramham et al., 2009; Marzocchi et al., 2009; Semrud-Clikeman, Walkowiak, Wilkinson, & Butcher, 2010).

Another segment of EF relates to emotional or behavior regulation, or elements of inhibition, shifting, and emotional control (Gioia, Isquith, Guy, & Kenworthy, 2000). Behavior regulation or self-regulation covers a wide variety of behaviors from being emotionally in control or regulated to being able to inhibit a response based on context or situation to being able to alter one's behavior in response to feedback. Students with deficits in self-regulation often experience difficulty both in academics and relationships.

Posner and Rothbart (2000) defined self-regulation as the child's ability to modulate his/her behavior according to the cognitive, emotional, and social demands of a given situation. These regulatory processes begin during prenatal development and evolve into self-initiated processes as the child develops from a toddler, to preschooler, to school age (Posner & Rothbart, 2000). Posner and Rothbart proposed that the self-regulatory system should be conceptualized as an adaptive control that may have

correlates to cognitive, behavioral, emotional, and interpersonal processing levels. Thus, the development of the self-regulation system affects more complex levels of regulation such as behavioral control and interpersonal processes (Stifter, Spinrad, & Braungart-Rieker, 1999). At the same time, the demands of the environment that necessitate changes (i.e., growth) in EF abilities over time and across differing contexts.

EF deficits can affect educational and social/behavioral functioning across development such that they may fail to adequately develop the requisite abilities to interact productively within their environment (Marlowe, 2000). Additionally, Brock, Rimm-Kaufman, Nathanson, & Grimm (2009) speaks of how problems with skills associated with EF are responsible for a variety of learning differences in reading, writing, math, and general learning. For example, dysfunction in working memory, a critical component of EF, can lead to difficulties in reading comprehension. Similarly, students with poor math skills often have trouble with multiple-step procedures that require regulation of working memory. Executive dysfunction also can cause difficulties in the use of strategies involved in memorization and retrieval (Geary, Hoard, & Nugent, 2012; Voss, Galvan, & Gonsalves, 2011). In adolescence and adulthood, with greater emphasis on independent functioning and planning for themselves, individuals with neurodevelopmental disorders may encounter difficulty living independently and attaining employment due to EF deficits (Anderson, Bechara, Damasio, Tranel, & Damasio, 1999; Diamantopoulou, Rydell, Thorell, & Bohlin, 2007; Kofler et al., 2011). Given the critical importance of EF, it is important to consider the long-term

psychological, academic, and social outcomes associated with disorders that are characterized by executive dysfunction.

EF and Relation to Academic and Social Development

Academic. The level of dysregulation associated with EF deficits directly affects educational outcomes across development. Educationally, most of the research has focused on the relation between EF with reading and math in conjunction with working memory and behavioral regulation, as well as cognitive flexibility (Bull et al., 2011; Espy, McDiarmid, Cwik, Stalets, Hamby, & Senn, 2004; Rose, Feldman, & Jankowski, 2011; St. Clair-Thompson & Gathercole, 2006; Zheng, Swanson, & Marcoulides, 2011). Children with EF deficits are at a greater risk for poor longer term outcomes such as lower educational and employment attainment (e.g., Abikoff, Gallagher, Wells, Murray, & Huang, 2013; Harpin, 2005; Seidman, 2006). In regards to writing, EF abilities such as planning and behavioral inhibition appear to play a role (Altemeier, Jones, Abbott, & Berninger, 2006); however, results have been inconsistent (DeShazo, 2000).

Metacognitive deficits (e.g., planning, organizing, identifying critical or relevant information) commonly result in the inability to: (a) work independently, (b) emotionally regulate when overwhelmed by novelty or complexity, (c) learn effectively from written text even though reading skills are intact, and (d) demonstrate knowledge of multi-step projects (e.g., lab and book reports). These metacognitive deficits often yield major problems with homework, which requires independent organization of time, materials, and information as well as the generation of a plan to complete the assigned task (Carcani-Rathwell, Rabe-Hasketh, & Santosh, 2006). If these metacognitive skills

are not explicitly taught to students with many disorders, they will be encounter difficulty in meeting the demands of the environment at school, home, and work as they progress into adulthood.

Academic skills are those skills necessary to succeed in school and often correspond to educational curriculum (Stetson, Stetson, & Sattler, 2001), whereas cognitive skills reflect one's ability to think and apply experiences and include abilities such as abstract thinking, working memory, processing speed, and visual processing (Sattler, 2008). Additionally, lower level language and academic related skills (Carcani-Rathwell, Rabe-Hasketh, & Santosh, 2006) and lower academic achievement, as measured by either standardized measures or school placement, have been associated with EF deficits (e.g., Alloway, Gathercole, & Elliott, 2010; Sarver et al., 2012). The link between academic success and EF deficits has been established for various forms of academic and cognitive skills, including reading (Massetti et al., 2008; Willcutt & Pennington, 2000), pre-literacy skills (Doctoroff, Greer, & Arnold, 2006), general achievement (Power, Werba, Watkins, Angelucci, & Eiraldi, 2006), and learning disabilities (Yu, Buka, McCormick, Fitzmaurice, & Indurkhya, 2006) in children with neurodevelopmental disorders.

For example, many aspects of EF, including the ability to shift cognitive set (i.e., cognitive flexibility), are related to mathematics achievement (Bull, Johnston, & Roy, 1999; Bull & Scerif, 2001; Marshall, 2008). Bull and Scerif (2001) demonstrated that children who demonstrate lower ability in mathematics have specific difficulty with inhibition of a learned strategy and flexible switching to a new strategy. Therefore, the

generation of an appropriate strategy to complete a task does not appear to be problematic; rather, the abandonment of that learned strategy for a new strategy is problematic and reflects cognitive inflexibility. The results also indicated that components of EF are diverse and make unique contributions to a child's performance (Bull & Scerif, 2001). Regression analyses revealed that inhibition, working memory, and perseveration all contributed independently to mathematics performance.

Research has indicated that children with neurodevelopmental disorders such as ADHD or ASD often experience adverse effects such as poor academic achievement and diminished social skill development as a result of EF deficits (e.g., Miller & Hinsaw, 2010; Volpe et al., 2006). In fact, there is evidence that academic underachievement is linked with both ADHD (e.g., Barkley, 2006; McClelland et al., 2007) and ASD (Power, Werba, Watkins, Angelucci, & Eiraldi, 2006). For example, Toplak, Bucciarelli, Jain, and Tannock (2009) investigated the performance of adolescents with ADHD and adolescents in a control group on performance-based measures of EF, as well as parent and teacher ratings. They found that adolescents with ADHD performed significantly more poorly on performance-based measures, and parents and teachers endorsed significantly more concerns with EF for these children than for those in the control group.

EF deficits have an indirect effect on reading achievement through variables such as level of motivation, interpersonal skills, and study skills in children with ADHD (DuPaul et al., 2004). Specifically, Du Paul et al. (2004) found that teacher ratings of these variables were predictive of reading ability. Additionally, Thorell (2007) indicated

that EF deficits act as a mediator between symptoms of inattention and both language skills and mathematics in children with ADHD for early academic skills. There was also a significant and direct effect of inattention on early academic skills. Barbaresi et al. (2007) found that children who meet criteria for ADHD tend to perform lower on standardized reading assessments than children who do not meet criteria.

Specifically, research has substantiated common deficits in reading achievement in children with ADHD (Biederman et al., 2004) and ASD (Power, Werba, Watkins, Angelucci, & Eiraldi, 2006). Comprehending abstract information in reading (e.g., metaphors, idioms, inference) is deficient in children with autism, despite adequate recall of factual information from reading (Church, Alisanski, & Amanullah, 2000). Individuals with ASD have difficulty comprehending what they read due to the complexity of language (Minshew, Goldstein, & Siegel, 1997; Minshew, Goldstein, Taylor, & Siegel, 1994). Children with ASD also evidence lower performance on standardized reading assessments; especially when asked to solve real-life questions using problem-solving skills (Griswold, Barnhill, Myles, Hagiwara, & Simpson, 2002).

In addition to academic concerns related to reading, children with ADHD and ASD also evidence problems with mathematics achievement (Biederman et al., 2006; Assouline, Foley-Nicpon, & Dockey, 2012). Children with ADHD display slower computational speed and perform worse on problem-solving, conceptual math tasks (Lucangeli & Cabrele, 2006). Marshall (2008) investigated various domains of executive functioning in relation to the types of arithmetic errors commonly observed in children with ADHD. Results of this study suggested that difficulties with inhibition

were most predictive of procedural errors, while concerns with inattention were predictive of "careless" errors in arithmetic. In regard to applied mathematical reasoning skills, Lucangeli and Cabrele (2006) discussed the importance of planning and working memory in mathematics reasoning skills for children with ASD. More specifically, mathematics word problems require an individual to retain and organize critical information to solve a problem. Giofre, Mammarella, Ronconi, and Cornoldi (2013) demonstrated that poor performance on working memory tasks is related to a failure to recall information critical to mathematics problem solving in children with ASD.

Several studies also have investigated academic performance in children with ADHD and autism compared to control group of typically developing children and children with mood related disorders (e.g., anxiety and depression). Mayes and Calhoun (2007) determined that control children performed better than children with ASD and ADHD in all areas assessed (learning, attention, graphomotor skills, and processing speed). Mayes and Calhoun also determined that significant differences between children with ADHD and ASD did not exist, except that children with ADHD have greater learning problems. Zayat, Kalb, and Wodka (2011) also found that on verbal based academic tasks, there were no significant differences in performance between children with ADHD and children with ASD.

Social. In addition to academic difficulties, EF deficits may negatively impact the ability of children neurodevelopmental disorders to develop social skills and build friendships with peers. Social interaction impairments associated with EF include the failure to form peer relationships at an appropriate developmental level, lack of social-

emotional reciprocity, impaired response to other people's emotions, lack of spontaneous sharing of enjoyment, interests, or achievements with others, lack of adapting behavior to different social contexts, and weak integration of social, emotional, and communicative behaviors (APA, 2000; Rogers & Vismara, 2008; Weiss & Harris, 2001). Many of these problems can be attributed to problems with self-regulation (i.e., emotion regulation, behavior regulation). Behavior regulation covers a wide range of behaviors from being emotionally out of control and dysregulated. Emotional regulation refers to efforts by individual to manage, modulate, inhibit, and enhance emotions (Cicchetti, Ganiban, & Barnett, 1991; Kopp, 1989; Thompson, 1994).

Students with deficits in self-regulation experience difficulty in learning and challenges with relationships. Deficits in EF are exhibited by children who are not able to use strategies such as attentional control, and avoidance, instrumental coping in the face of anger or fear inducing events (Kleinert, Miracle, & Sheppard-Jones, 2007). Prior research using normative samples have demonstrated that children with poor emotion regulation are more likely to exhibit aggressive and uncontrolled behaviors in social interactions (Blair et al., 2014; Blandon, Calkins, Grimm, Keane, & O'Brien, 2010; Calkins, Gill, Johnson, & Smith, 1999; Eisenberg et al., 1993) and experience rejection and isolation by peers (Hanish & Guerra, 2004; Kim & Cicchetti, 2010).

Children with ASD, ADHD, and other neurodevelopmental disorders have difficulty with higher order mental organization and planning, as well as processing multiple levels of information (i.e., EF difficulties), which likely affects their ability to successfully interact socially with others (e.g., Solanto, Pope-Boyd, Tryon, Stepak,

2009; Solomon, Goodlin-Jones, & Anders, 2004). Deficits and delays in the development of social skills hinder an individual's ability to develop meaningful social relationships and have been associated with peer rejection, poor academic achievement, anxiety, depression, and other forms of psychopathology (Bellini, Peters, Benner, & Hopf, 2007). Children with neurodevelopmental disabilities are also less likely to participate in school based or after-school activities in comparison to typically developing peers (e.g., Kleinert, Miracle, & Sheppard-Jones, 2007), offering fewer opportunities to develop and practice social skills.

In a classroom setting children with ADHD and ASD are required to work cooperatively with others. Due to their provocative, immature, and frequently aggressive behavior, this type of collaboration is often difficult or even impossible (Greydanus, Pratt, & Patel, 2007). This immediately makes those with ADHD and ASD less popular and further hinders social proficiency. Another observed issue in a situation like this involves attention, or lack thereof. A student with ADHD and ASD is more likely to get distracted or become disorganized and not fulfill their obligations to the group, providing another reason for social rejection. This type of cooperative environment is not exclusive to the classroom. Lack of collaborative skills has an equally deleterious effect on activities outside the classroom or office, including play dates and sporting endeavors (Bauminger-Zviely et al., 2013; Chevallier et al., 2012).

In addition to educational and vocational impairments, it is also suggested that children with ADHD present with concerns related to social and relationship development. ADHD has a distinguishable effect on social functioning (Barkley, 2006).

Those individuals with ADHD have fewer friends, decreased self- esteem, and struggle to maintain the peer relationships they do have. Peers without ADHD often find the impulsive and hyperactive behaviors of children with ADHD to be undesirable and these behaviors act as a repellent to peers (Di Pinto, 2006). This deficit in social functioning also reaches across domains of functioning such that children with ADHD have poorer relationships with peers, parents, teachers, and employers (Greydanus, Pratt, & Patel, 2007).

Likewise, research with children with ASD has demonstrated a direct association between social impairment and adjustment difficulties. For example, White and Roberson-Nay (2009) reported a negative correlation on parent reports of adjustment difficulties and social competence in a sample of youth with ASD. Additionally, Vickerstaff, Heriot, Wong, Lopes, and Dossetor (2007) found that self-perceived social competence significantly predicted emotional adjustment for youth with ASD, although parent and teacher reports of social competence and emotional symptoms did not yield similar results.

While adjustment may be impacted by social impairment, it is also possible that the quality of one's friendships may affect a person's adjustment. Research has demonstrated that youth with ASD report having fewer friends and spend less time interacting with friends. A study of 235 adults and adolescents with ASD found that less than one in 10 reported interacting with same-aged friends on a weekly basis outside of an organized activity and approximately one-half of the sample reported having no same-aged friends (Orsmond, Krauss, & Seltzer, 2004), suggesting that adolescents with

ASD have fewer opportunities to develop quality friendships. If a person does not have the opportunity to develop quality friendships in day-to-day life, the impact on their adjustment may be significant.

In addition, EF deficits may be negatively impacting the ability of ASD adolescents to develop quality friendships. Carrington, Templeton, and Papinczak (2003) interviewed youth diagnosed with Asperger's Disorder and found that they demonstrated compromised EF abilities (i.e., cognitive inflexibility) when making decisions about friendships. For example, participants reported not being willing to make friends with someone who broke rules, even if it was for a valid reason. As a result, the quality of friendships that are being made and maintained in this population may be impacted by that person's EF abilities. Therefore, it is important to recognize that friendship quality may not only be contributing to increased levels of loneliness and depressive symptoms in the adolescent ASD population, but may be affected by compromised EF abilities. Thus, it is evident that research supports the need to focus intervention on EF as related to academic, social, and behavioral components for children with ADHD, ASD, and other neurodevelopmental disorders.

Interaction of Academic and Social Difficulties. Students who have difficulty establishing and sustaining social interactions with peers, parents, and teachers typically also show impairments in academic achievement (e.g., Ray & Elliott, 2006; Welsh et al., 2001). Welsh and colleagues (2001) concluded that the best approach to increase academic competence for students that struggle socially would be to include a social skills intervention to the educational curriculum. Ostmeyer and Scarpa (2012) found

that poor social skills and peer rejection in kindergarten correlates with difficulty in academic achievement in later years. Also, how well students with neurodevelopmental disorders are involved in the learning process and classroom environment is contingent upon relationships with peers and the classroom teacher (Robertson, Chamberlain, & Kasari, 2003). Given these findings, interventions that address social competencies also may serve to improve academic competence.

Several studies have investigated the relationship between academic achievement and social development of children and adolescents with ASD and ADHD (e.g., Biederman et al. 2004; Diamantopoulou et al. 2007). Miller and Hinshaw (2010) investigated the ability of measures of neuropsychological functioning administered in childhood to predict academic, social, and global functioning in adolescents. Results indicated that measure of EF and general neuropsychological functioning in childhood EF predicted (a) social functioning and academic achievement and (b) global functioning, independent of IQ. Thus, these results emphasize the non-specificity of EF deficits and suggest the importance of developing and assessing interventions that target EF impairments, particularly in those at high-risk for negative outcomes, in order to prevent long-term difficulties across a range of essential functional domains.

EF-Focused Intervention

As noted above, there is an abundance of research on EF deficits in children and adolescents with ASD (e.g., Russo et al., 2007; Sachse, Schlitt, Hainz, Ciaramidaro, & Schirman, 2013) and ADHD (e.g., Martel, Nikolas, & Nigg, 2007; Willcutt et al., 2005), as well as other neurodevelopmental disorders (Zelazo & Müller, 2002). Also reported

previously, EF deficits in children and adolescents are associated with poor academic outcomes (e.g., Loe & Feldman, 2007; Power, Werba, Watkins, Angelucci, & Eiraldi, 2006), as well as difficulties with social skills and friendship development (e.g., Miller & Hinshaw, 2010; Volpe et al., 2006). Observed deficits in EF are predictive of negative long-term outcomes in adolescence and adulthood (Barkley & Fischer, 2011; Wilens et al., 2011; Wu et al., 2011). These findings underscore the need for the systematic use of curriculum to teach or promote EF skills in many different educational settings. In fact, over the past decade, there has been increased interest in intervention planning and rehabilitation for children and adolescents with EF deficits.

Programs for Children with Neurodevelopmental Disorders

Although the literature is growing related to the importance of EF, relatively little addresses EF interventions (Mahone & Slomine, 2007; Riccio & Gomes, 2013; Riccio, Sullivan, & Cohen, 2010), with very few studies employing large samples or randomized controlled trials. The discussion that follows focuses on broadly defined programmatic approaches to intervention: (a) self-regulated learning and strategy instruction, (b) Montessori approach, (c) therapeutic milieu model, (d) combined approaches, and (e) behavioral interventions. These are not the only interventions available, but they are relevant when looking at school-based programmatic interventions.

Self-regulated learning. Self-regulated learning strategy is referred to as actions directed at acquiring information or skill that involve agency, purpose (goals), and instrumental self-perceptions by a learner (Bronson, 2000; Kopp, 1989; Zimmerman, 1986). Self-regulated learning can be used in the school setting and emphasizes

metacognitive strategies to improve executive functioning and academic success. Research indicates the need to focus on the process of learning, as well as the content, striving to teach student the how, why, and what of learning while providing strategy instruction that is explicit, systematic, and linked to the curriculum. (Meltzer, 2011). Harris and Graham (1996) developed a model of self-regulated strategy instruction, called *self-regulated strategy development* (SRSD). It encompasses components that focus on attention, memory and EF and was designed to address behavioral, cognitive, affective, social, and ecological aspects of learning. Their model focused primarily on work in reading, writing, and mathematics. It is an elaborate system of many components and seven instructional stages and requires a fairly self-regulated learner to participate in the process.

Wehmeyer, Palmer, and Agran (2000) presented results of a field test designed to assess the effectiveness of a self-determined learning model of instruction for students with emotional disturbance, learning disabilities, and mild intellectual disabilities. Teachers were trained to organize instruction throughout the curriculum around several questions presented in three phases of the program (goal setting, planning, and reviewing). Students and teachers reported positive results. Students receiving instruction from teachers using the model attained educationally relevant goals and showed enhanced self-determination. Teachers implementing the learning model reported satisfaction with the process and indicated that they would continue to use the learning model after the completion of the field test.

Another self-regulated learning model that attempts to teach appropriate components related to the development of EF is the *Stop & Think Social Skills Program.* This program, (Knoff, 2001; Knoff, 2009) uses a five-step series of questions to teach the EF components of self-control, self-awareness, planning, and practice skills. The sequential steps are: (a) this is a self-control, self-management step designed to condition the student to think before acting. *Stop and think;* (b) this question prompts and encourages students to make good choices. *Are you going to make a good or bad choice?*; (c) educators teach specific skills scripts for each *Stop-and-Think* skill so that students learn and are better able to demonstrate good choices more independently during subsequent attempts. *What are your choices or steps?*; (d) Students actually carry out the plan and then evaluate whether or not it worked. *Do it!*; (e) Students receive positive reinforcement for good actions. The effectiveness of this program has been demonstrated in numerous school settings, from elementary grade levels through high school (Hall, Jones, & Claxton, 2008; McMurran, Egan, Duggan, 2005). It is considered a program that focuses on social skills, not a program for teaching the requisite skills to increase EF. At the same time, such a program may positively influence some aspects of EF by introducing students to a paradigm of cognitive control over behavior. Students with EF deficits do not always have the inhibitory skills necessary to review the question *Are you going to make a good or bad choice?*(de Boo & Prins, 2007; Miranda & Presentacion, 2000).

Another program, referred to as the *Goal-Plan-Do-Review* (GPDR) system, suggests the use of a general executive problem-solving routine that promotes (a)

systematic goal definition; (b) planning; (c) action; (d) self-monitoring/evaluating; and (e) flexible, strategic adjustment of plans and actions (Ylvisaker, Feeney, & Szekeres, 1998). The applied research (Ylvisaker & Feeney, 2000, 2002; Ylvisaker, et al. 1998) offers general principles of intervention that advocate for an ongoing (a) contextualized, (b) collaborative (i.e., involving the child, teachers, parents, and peers), and (c) hypothesis-testing (i.e., generating and implementing testable procedures) assessment and treatment approach. Embedding EF intervention in real life routines is supported in studies of normal development (Rogoff, 1990).

Cleary and Zimmerman (2004) developed the *Self-Regulated Empowerment Program* (SREP) to help adolescent students participate in more positive, self-motivating cycles of learning. They detailed a two-part approach that utilizes self-regulated learning coaches who (a) use microanalytic assessment procedures to observe and report on student self-regulation beliefs and study strategies and, (b) train students to use these strategies in a self-regulation feedback cycle. Interviews with students provide information about self-perceptions of the learning styles and assess how effective they are in setting and accomplishing goals. Involving the student in the process empowers them to learn about their unique learning habits, where they are strong, and where they need practice. Ultimately, the student takes over the role of the coach and regulates their own learning.

Bashir and Singer (2005) described EF as separate from, but serving in support of self-regulated learning in the process of writing. The *EmPOWER* program is a strategic approach to learning written expression that explicitly teaches how to engage

all the domains required for writing. This approach acknowledges the need for the internal language, executive, and regulatory processes necessary for writing. Specifically, it outlines the skills of evaluating, making plans, organizing, doing the work, evaluating the work, and re-working to improve production. This process continues until a successful written outcome exists.

Montessori Approach. Influenced by the work of Itard (1801, 1962) and Seguin (1839), the Montessori approach focuses on a method of education for children with disabilities. It stresses the importance of developing self-reliance and independence through a combination of physical and intellectual tasks that allow them to practice planning and organizing (Montessori, 1967). This approach emphasizes the importance of early education and the use of assessment information to develop a remediation plan (Gartrell, 2012).

The Montessori model explicitly teaches thinking skills for metacognition. Through guided practice in the *discovery* method of learning, a child learns systematically through making errors. This incorporates a *plan, act, review* form of practice that research supports as successful in increasing skills of EF including planning and organizing, working memory, and monitoring (Barkley, 2006; Gioia, et al. 2000). For Marlowe (2000), Montessori's principles were relevant to the teaching of EF and included the following: (a) thinking is a skill that can be taught; (b) thinking skills are best taught by direct and systematic instruction; (c) when teaching thinking skills, the teacher should emphasize the process of thinking, not the product; (d) thinking skills

should be used consistently and across environments; and (e) thinking skills must be taught over a period of years and tailored to developmental expectations.

Therapeutic Milieu Model. Children and adolescents with deficits in inhibitory control often encounter problems due to risk taking behavior (Mullan, Wong, Allom, & Pack, 2011; Selemon, 2013; Telzer, Fuligni, Lieberman, & Galván, 2013) and one possible approach to treatment is a setting that offers care through a therapeutic milieu model. The therapeutic milieu model, also referred to as the community therapy model, is an approach to that emphasizes modeling, personal responsibility, and peer feedback in a structured environment. It supports that each interaction with others holds the potential for personal growth and social learning because one's psychological difficulties are said to inevitably be expressed in the context of relationships (Daniels-Zide & Ben-Yishay, 2000).

One therapeutic milieu model that has shown to be successful is the *Girls and Boys Town Education Model* (GBTEM; Caldwell, 2009; Gross & Hawkins, 2007) that was developed in 1979 and is an extension of the *Boys Town Family Home Program* (Casey et. al, 2010) and the *Teaching Family Model* (Kirgin, 2001; Phillips, Phillips, Fixsen & Wolf, 1971). The GBTEM program was developed for use with children who were considered delinquent. Key components of this method includes a curriculum of specific skills taught as expectations in the classroom and teaching alternative behaviors to inappropriate behaviors rather than relying on punishment to reduce behaviors. This method incorporates a multi-level token economy to increase motivation and focus on student's strengths in creating relationships between staff and students; however,

research suggests that token economies have limited capacity to affect long term gains in teaching new skills (Caldwell, 2009; Cotton, 1993).

There is a growing concern that procedures of therapeutic milieus such as time outs, quiet rooms, restraint, and seclusion are ineffective for helping individuals develop inner controls, coping skills, and interpersonal skills (Cotton, 1993; Gair, 1980, 1984). Young people who display poor EF by exhibiting deficits in their ability to inhibit or control their emotions may not be well served in such restrictive environments. Further, for those individuals with deficits in the metacognitive indices of executive functions such as the ability to initiate, plan/organize and/or monitor, a therapeutic milieu may not be appropriate (Ellis, Weiss, & Lochman, 2009).

Applied Behavior Analysis. Other models of intervention have been used extensively with the intervention of children with ASD like Applied Behavioral Analysis (ABA). ABA is the systematic process of applying interventions based upon the principles of learning theory to improve socially significant behaviors to a meaningful degree, and to demonstrate that the interventions employed are responsible for the improvement in behavior. ABA addresses the component of self-regulation in EF by focusing on teaching compliant behaviors (Baer, Wolf & Risley, 1968; Newton et. al, 2012). The method focuses on behaviors that need to be changed. Once the behavior is identified, intervention strategies are determined to suit the situation and then used to modify the behavior. While ABA has shown to be successful in altering behaviors in individuals with autism, it is not generally used with the range of diagnoses that include EF deficits.

TEACCH Program. Another more inclusive, multi-approach model is the *Treatment and Education of Autistic and Communication Handicapped Children* (TEACCH; Schopler, 1970; Schopler, 1994). TEACCH is a complete program of services for people with autism that uses several techniques and methods in various combinations, depending upon the individual's needs and emerging capabilities. The TEACCH approach includes a focus on the development of a program around this person's needs, skills, and interests. TEACCH techniques are helpful to advance executive function skills of inhibit and shift and include the use of visual systems that make it clear to the student when they will transition from task to task (Mesibov & Shea, 2010; Panerai, Ferrante, & Zingale, 2002). The use of visual systems relieves anxiety that might lead to impulsive behavior and allows the student to feel competent about knowing what is expected of them next. TEACCH techniques also are helpful to advance EF skills of initiate, working memory, plan/organize, and monitor, include building work systems that make it clear for the learner to know where to be, what to do, and what to do when they are finished with a task (Mesibov & Shea, 2010). These can be considered preliminary skills that might lead to the more sophisticated practice of plan-act-review (Mesibov, Shea, & Schoper, 2002; Probst, Jung, Micheel, & Glen, 2010).

The Monarch School. While each of these approaches attempts to address some aspects of EF, they do not offer comprehensive, strategic curricula designed to address or promote the development of EF in children with neurodevelopmental deficits such as ASD, ADHD or other neurodevelopmental disorders. The Monarch School (TMS) is a

private non-profit therapeutic day school in Houston, TX serving children with neurological differences who require a program that provides cognitive, emotional, and social development components. The school operates a standard 10-month academic year with an optional five-week therapeutic summer program. Roughly eighty percent of the students attend the summer program in addition to the standard academic year. At TMS, educators, psychologists, speech language pathologists, licensed music therapists, and a licensed Brain Gym® instructor work collaboratively with the student and his or her family to develop a treatment plan. In the classrooms, student-teacher ratios are as low as 2 to 4 and as high as 1 to 6. Teachers receive a minimum of 35 hours of training in the summer before the academic year they begin working with the students and each year thereafter.

TMS is a school-based model that exists in several schools both nationally and internationally. The model for TMS is designed to address each student's skills in four core goal areas: (a) self-regulation; (b) executive function; (c) social development; (d) academic competence (see Figure 1). These goal areas include components of development that are essential features of executive functioning. TMS curriculum recognizes elements of executive functioning education for students across these four core goals. These core areas are based on Piaget's (1963) model of developmental stages that we used to outline a sequential progression through objectives divided into a level system founded on Barkley's (1997) theory that a shift occurs from external control to internal control for children. At the same time, the TMS model is designed to honor what research has found to be developmentally appropriate to growth of EF in children

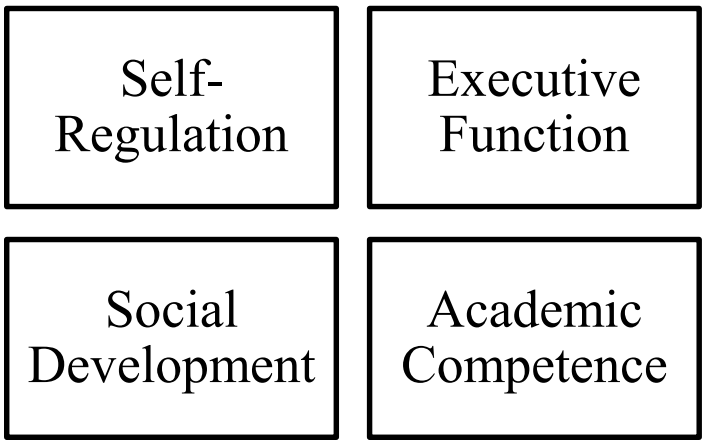
and adolescents (e.g., Anderson, 1998; Levin et al., 1991; Raskind, Goldberg, Higgins, & Herman, 2002; Welsh et al., 1991). TMS core goals are designed to help the student acquire complex skills, take on greater responsibilities, and develop greater competence over time.

The level system within the Monarch School consists of four distinct levels but at TMS the levels are combined into two groups with similar, but slightly different programming: (a) Novice and Apprentice levels, and (b) Challenger and Voyager levels. At the Novice and Apprentice levels, the EF of self-regulation is the main focus. Regulation includes and is influenced by the student's motivation and emotional state, cognition, behavior, and social environment concurrently (Sexton, Graham, & Harris, 1998). The TMS program is closely associated with the BRI on the BRIEF and the EF content scale on the BASC-2 since they include constructs related to shifting, inhibition, and emotional control. The curriculum and practices at these levels are designed in consideration of the stages of EF development and chronological age. The Novice and Apprentice levels are designed to promote organization and predictability, with opportunities for practice, and help the students create knowledge structures for understanding events and to develop a sense of self as competent and effective (Bronson, 2000).

At the Challenger and Voyager levels, students are encouraged to reflect upon their performance to make plans and use strategies to advance their progress and take ownership of personal development. Metacognition and self-regulation are targeted as students practice organizing plans and monitoring their thoughts and behaviors and

exercise control as regulated individuals. The TMS program is closely associated with the metacognition scale on the BRIEF and the Study Skills on the BASC-2 Teach form since they include constructs related to initiating, working memory, planning, organizing, and monitoring. At these levels, students have demonstrated that they can manage academic learning and relationship skills in a school environment. Thus, TMS program at the Challenger and Voyager levels focuses on the students' abilities to balance multiple demands, problem solve, demonstrate flexibility. The program seeks to use practice and guidance through an individualized and group structure to develop coordination, competence, and social skills.

Figure 1. Core Goals of TMS



CHAPTER III

METHODS

Research Design

The study used data that was collected by TMS for progress monitoring. Data from the years 2011-2014 was used for this study. The study has both retrospective and prospective components with data examined both cross-sectionally and longitudinally.

Participants

Records reviewed for this study are for students who attended a private non-profit therapeutic day school, TMS in Houston, TX, from August, 2011 to May, 2014. Although students at TMS range in age from 3 to 32 years, the sample of records reviewed included 77 boys and 19 girls, $n = 96$, who ranged in age from 5 to 17 years of age to ensure availability of data on measures of interest. They were predominantly white non-Hispanic (69.8%, n=67) and of middle-upper class based on TMS student demographic information from 2013-2014. These students had a mean age of 12.27 years (SD=2.92).

A requirement of admission into TMS is that students have documentation of their cognitive ability level and their diagnoses at entry. Diagnostic information must be received from licensed professionals using the categories as described within the Diagnostic and Statistical Manual of Mental Disorder, Fourth Edition, Text Revision (DSM-IV-TR; American Psychiatric Association [APA], 2000) and testing must be current to within one year of the admission application. There is no uniformity to the

information received or the assessment measures used to meet these requirements; assessments are not updated through TMS.

Based on entry records, children in the sample have a clinical diagnosis of ADHD/ASD (*n*=51; 53.1%), ASD (*n* =23; 23.9%), ADHD (*n*=18; 18.8%), ADHD/Other (*n*=2; 2.1 %), ASD/Other (*n*=2; 2.1%). Other diagnosis was a mood disorder or anxiety disorder. Students varied in the number of years they participated in the program at TMS. For this sample of students, the average enrollment in the program through 2013-2014 was 3.31 years (SD=1.77). Information on estimated cognitive ability was not used due to the extent of variability in measures used, versions of measures used, and lack of validation.

Although data existed in some form for seven years, only data from August 2011 to May 2014 was used for this study. In some years, data were collected in Fall and Spring; in some years, data were collected only in the Spring. For any given student, the maximum number of data points was five (2 in 2011-12, 1 in 2012-13, and 2 in 2013-14). Not all students were enrolled for all four years; students with data collected for less than two cycles were not be included in the study. With this taken into consideration, nine students were excluded from longitudinal analysis resulting in the 96 participants.

Instruments

The instruments used for this study are those that have been or are being given at TMS during the years 2011-2014. Specific variables will serve as independent variables

to represent the core goals of TMS, while others will be dependent measures that reflect outcome. Variables by construct are presented in Table 1.

Table 1

Measures and Variables for Analyses

Core Goals	Independent Variables	Outcome Variables
Self-Regulation	BRIEF-Behavior Regulation Index	Academic Achievement (GRADE and GMADE)
Executive Function	BASC-2- Executive Function BRIEF- Metacognitive Index BASC-2- Study Skills*	Emotional Adjustment (BASC-2: Behavior Symptom Index and Adaptability)
Social Development	SSIS- Social Skills BASC-2- Developmental Social Disorder	
Academic Competence	SSIS- Academic Competence BASC-2- Learning Problems*	

Note. BRIEF= Behavior Rating Inventory of Executive Function; BASC-2= Behavior Assessment System for Children, Second Edition; SSIS = Social Skills Improvement System; GMADE= Group Mathematics Assessment and Diagnostic Evaluation; GRADE= Group Reading Assessment and Diagnostic Evaluation; *Only available on teacher forms.

Behavior Rating Inventory of Executive Function. (BRIEF; Gioia, Isquith, Guy, & Kenworthy, 2000). The BRIEF measures behaviors at home and at school for children and adolescents ages 5–18. The questionnaire contains 86 items in eight non-overlapping clinical scales and two validity scales. The BRIEF is completed by parents or teachers (two different forms). Items are rated on a Likert-type scale (never, sometimes, often, always) comparing the frequency of the child's behaviors to those of other children of the same age over a specified period of time. These theoretically and statistically derived scales form two broader Indexes: Behavioral Regulation (three scales: Inhibit, Shift, Emotional Control) and Metacognition (five scales: Initiate, Working Memory, Plan/Organize, Organization of Materials, Monitor), as well as a Global Executive Composite score. This questionnaire takes approximately 10-15 minutes for a rater to complete. For the purpose of this study the variables of interest will be the Behavioral Regulation and Metacognition Indexes as research has indicated that these indexes appear to measure constructs outlined in core goals (self-regulation and executive function) of TMS.

The BRIEF is reported to evidence convergent and divergent validity, moderate concurrent validity, and discriminant validity of the BRIEF indexes and scales (Gioia, Isquith, Retzlaff, & Espy, 2002; Huizinga & Smidts, (2011). Further studies also found evidence of moderate to high convergent, divergent, and concurrent validities, as well as good discriminant validity (Sherman, & Brooks, 2010). McCandless and O'Laughlin (2007) examined the convergent validity of the BRIEF Parent and Teacher Forms among 70 children (5–13 years old) referred by physicians for an ADHD evaluation. The

results indicated low interrater reliability (0.12-0.42) on the BRI and MI Indexes but acceptable convergent validity. Additionally, Toplak et al. (2009) examined the convergent validity between the BRIEF Parent and Teacher Forms and performance-based measures of executive functions in 46 adolescents with ADHD and 44 unmatched controls. Results indicated that both BRIEF forms were more useful in predicting ADHD status than performance-based measures, providing further support for the clinical utility of the BRIEF Parent and Teacher Forms in the diagnosis of ADHD.

Discriminant validity of the BRIEF GEC or indices has also been examined with youth correctly classified as having ADHD from matched controls approximately 77 to 86 percent of the time (Reddy, Hale, & Brodzinsky, 2011). The BRI was found to be more potent than the MI in discriminating between the groups. Likewise, the eight BRIEF scales produced an overall correct classification rate of 82% for children with ADHD, and controls were correctly classified 84 percent of the time. Among the scales, Shift, Emotional Control, and Working Memory were found to contribute more significantly as compared with the other five scales (Reddy, Hale, & Brodzinsky, 2011). Multivariate analysis of variance results indicated statistically significant higher scale scores on the Metacognition Index and Inhibit scale for participants with ADHD as compared to those without ADHD (Donders, DenBraber, & Vos, 2010). On the BRIEF, internal consistency coefficient alphas were .84 on the BRI and .88 on the MI (Gioia et al., 2000). Similar studies have found reliabilities with alphas of 0.82 and 0.94 (McAuley, Chen, Goos, Schachar, & Crosbie, 2010). Test-retest reliability coefficients of 0.92 and 0.90 have been reported for the BRI and MI respectively (Gioia et al., 2000)

with other studies yielding reliabilities of 0.86 and 0.89 (Qian, Shuai, Cao, Chan, & Wang, 2010).

Social Skills Improvement System. (SSIS; Gresham & Elliott, 2008). The SSIS rating scales are screening measures that assist with classifying students ages 3-18 who are assumed to have significant social skill concerns. The SSIS uses a multi-rater approach that provides a comprehensive examination of social skills, problem behaviors, and academic competence. The two SSIS Rating Scales Forms used for this study include the Parent Form composed of 79 items and the Teacher Form composed of 83 items. The items are presented on a 4-point Likert-type scale (N: Not true: scoring 1, L: Little true: scoring 2, A: a lot of true: scoring 3 and V: Very true: scoring 4). The rating scale takes approximately 10-25 minutes for a rater to complete. The Social Skills Index measures seven areas: communication, cooperation, assertion, responsibility, empathy, engagement, and self-control. The Problem Behaviors Index measures five areas: internalizing, externalizing, bullying, hyperactivity/ inattention, and autism spectrum. The Academic Competence Scale measures three areas: reading achievement, math achievement, and motivation to learn. The SSIS includes three validity indices: F Index, Response Pattern, and Response Consistency. For the purpose of this study, as a measure of social cognition and academic competence, the Social Skills Scale and Academic Competence Scale will be used (Gresham & Elliott, 2008).

On the parent form, internal consistency reliabilities (alphas) of 0.74-0.96, a test-retest reliability of 0.86, and inter-rater reliabilities of 0.50-0.62 for Social Skills and Academic Competence are all adequate (Gresham & Elliott, 2008). Similarly, Gresham,

Elliott, Vance, & Cook (2011) found internal consistency reliabilities (alphas) of 0.97 for Social Skills, and 0.96-0.97 on Academic Competence for parent and teacher forms. Gresham et al. (2010) reported inter-rater reliabilities of 0.35-0.70 and parent-teacher agreements of 0.15-0.39 on Social Skills and Academic Competence Scales.

Behavioral Assessment Scale for Children, Second Edition. (BASC-2; Reynolds & Kamphaus, 2004). The BASC-2 is a behavioral assessment system designed for use in evaluating children and adolescents with cognitive, emotional, or learning disabilities. The scales and forms included in this study are the Teacher Rating Scales (TRS) and Parent Rating Scales (PRS) for child (6-11 years) and adolescent (12-17) years). The raters are asked to complete a questionnaire with each item designed as a 4-point Likert-type scale (never, sometimes, often, almost always). The TRS contains 100-139 items and the PRS contains 134-160 items depending on the age of the student. The rating scale takes approximately 10-20 minutes for a rater to complete. The BASC-2 measures externalizing, internalizing, adaptive behaviors, as well as clinical scales. Notably, because the measure is intended to be developmentally appropriate, all forms do not yield all the same subscales. For the TRS and PRS, the Composite Scales include: Adaptive Skills (AS), Behavioral Symptoms Index (BSI), Externalizing Problems, and Internalizing Problems; the TRS also includes a School Problems scale. For the purpose of this study, the scales of interest are the Study Skills and Learning Problems Composite on the Teacher Form and the Social Developmental Social Disorders and Executive Function Content scales. These scales will be used as they

appear to measure constructs outlined in the four core goals (self-regulation, executive function, social development, and academic competence) of TMS.

As expected the BASC-2 was highly correlated (in the .90s) with the previous BASC. Similarly, the PRS scale was compared with other behavioral measures such as the ASEBA Child Behavior Checklist for Ages 1-5, the Conners' Parent Rating Scale-Revised, and the BRIEF. Generally, the BASC-2 correlated in the 0.70s and 0.80s with these scales (Reynolds & Kamphaus, 2004). Dowdy, Chin, Twyford, and Denver (2011) reported evidence of discriminant and convergent validity for externalizing, internalizing, and adaptive skills composites.

The test-retest reliabilities were calculated for TRS and PRS and yielded average correlations in 0.80s for composite scores and between 0.70-0.80 for individual scales across all age groups. Inter-rater reliability analysis was performed for the Teacher and Parent reports for a significant amount of the scores and reliabilities ranged from 0.69 to 0.77 (Mahan & Matson, 2011). Median reliabilities for composite and content scores ranged from 0.57 to 0.74, and median reliabilities ranged from 0.53 to 0.65 across individual scales for the TRS sample. The PRS sample had median reliabilities for composite and content scores and individual scales in the 0.70s (Dowdy, Chin, Twyford, & Dever, 2011).

Group Mathematics Assessment and Diagnostic Evaluation and Group Reading Assessment and Diagnostic Evaluation. (GMADE & GRADE; Williams, 2004; Williams, 2001). The GMADE and GRADE are norm-referenced, diagnostic tests that measure individual student skills in the main areas of math and reading from pre-

kindergarten to young adult (Grade 12). On the GMADE skills measured include Concepts and Communication, Operations and Computation, and Process and Application. The GRADE measures skills such as Oral Language, Comprehension, Vocabulary, Phonological Awareness, and Early Literacy Skills. The GMADE and GRADE use a paper and pencil method and take approximately 50-90 minutes for each assessment to complete. Both assessment measures are scored using a computer software program. The GMADE and GRADE provide percentiles, grade equivalents, standard scores, and growth scale values. For the purpose of this study, standard scores and growth scale values will be used. GMADE and GRADE scores will provide evidence of academic outcome.

On the GMADE and GRADE, rest-retest reliabilities yield coefficients of 0.77-0.96, internal reliability of 0.91-0.99, and alternate form reliability of 0.81-0.94 for students ages 4-18 years. In terms of validity, it is evidenced that the GMADE and GRADE have criterion related validity coefficients of 0.78-0.87 and predictive validity coefficients of 0.63-0.90 across Grades 1-6, Middle School, and High School forms (Fugate, 2002).

Procedures

Each semester student data was collected as a part of routine monitoring of student progress. The BRIEF, BASC-2, and SSIS were included as part of the standard assessment battery for students at TMS and parents provided informed consent to use assessment data for research purposes. The BRIEF was consistently completed by the parent and teacher for the three years. The SSIS was inconsistently completed by the

parent and teacher for three years, depending on the student's placement at TMS. Students at the Novice/Apprentice levels had parent and teacher data from the SSIS for three years. Students at the Challenger/Voyager levels did not have consistent parent and teacher data from the SSIS. Additionally, SSIS was completed by the parent and teacher. Beginning in 2013-2014, the BASC-2 was completed by the parent and the teacher, and the GMADE/GRADE was administered.

Teacher information was obtained from each student's classroom teacher or the teacher that spent the most time with the student for children who had more than one teacher. The information from the rating scales was entered into the computer scoring program by TMS staff after being trained on the scoring software for each rating scale. The information was entered and scored at the end of each semester. IRB approval for existing data and IRB for current data collection was obtained. All data was entered into SPSS without any personal identifying information.

CHAPTER IV

RESULTS

This is both a retrospective and prospective study. Data collection was carried out initially by examination of existing data from archival student files back to 2011 (retrospective). Current year data (2013-2014) was added to the archival data (prospective). This study included some descriptive statistics, correlational analyses, and regression analyses. Students with any missing values were excluded from the analysis that data are used for. Data was analyzed to check for assumptions of normality; however, given that this is a clinical sample, it was expected that some assumptions will be violated.

Assumptions of Normality

To determine whether the data conformed to a normal distribution, skewness and kurtosis were examined. A strong value for skewness, which is a statistical characteristic that examines the symmetrical distribution, is ± 1, while a value ±2 is considered adequate. A strong value for kurtosis, which is a statistical characteristic that examines the relative height and weight of a distribution, is ±1, while a value ±2 is considered adequate (Thompson, 2006). Data were analyzed for kurtosis and skewness for the Spring 2014 data point by source (see Table 2). The descriptive analysis was completed. Values for both skewness and kurtosis were excellent. Thus, data transformations were not necessary. Skewness and kurtosis values are summarized in Table 2. All statistics are consistent with what would be expected for normality.

Table 2

Assumptions of Normality

Variable/Scale, Rater	N	Kurtosis	SEM	Skewness	SEM
BRIEF BRI, Teacher	83	.14	.52	.46	.26
BRIEF BRI, Parent	78	-.35	.54	.05	.27
BRIEF MI, Teacher	83	-.13	.52	.54	.26
BRIEF MI, Parent	77	-.56	.54	.13	.27
SSIS SS, Teacher	94	-.41	.49	.00	.25
SSIS SS, Parent	89	-.56	.51	.05	.26
SSIS AC, Teacher	94	-.88	.49	.13	.25
BASC-2 EF, Teacher	93	.11	.50	-.06	.25
BASC-2 EF, Parent	90	.14	.50	.37	.25
BASC-2 StS, Teacher	93	-.09	.50	.63	.25
BASC-2 LP, Teacher	92	-.28	.50	.47	.25
BASC-2 DSD, Teacher	93	-.71	.50	-.10	.25
BASC-2 DSD, Parent	90	.07	.50	-.29	.25
BASC-2 BSI, Teacher	92	-.19	.50	-.26	.25
BASC-2 BSI, Parent	90	.03	.50	.08	.25
BASC-2 AS, Teacher	93	.31	.50	.68	.25
BASC-2 AS, Parent	90	-.27	.50	.04	.25
GMADE	80	-.35	.53	.20	.27
GRADE	75	.34	.55	.39	.28

Note. BRIEF= Behavior Rating Inventory of Executive Function; BASC-2= Behavior Assessment System for Children, Second Edition; SSIS = Social Skills Improvement System; GMADE= Group Mathematics Assessment and Diagnostic Evaluation; GRADE= Group Reading Assessment and Diagnostic Evaluation; BRI= Behavior Regulation Index; MI= Metacognition Index; SS= Social Skills; AC= Academic Competence; EF= Executive Function; StS= Study Skills; LP= Learning Problems; DSD= Developmental Social Disorders; BSI= Behavior Symptoms Index; AS= Adaptive Skills.

Research Questions

Research Question: Core Goal Correlations. What is the relation between the results on measures used to represent the four core goals of the TMS program (self-regulation, executive function, social development, academic competence) as measured

by parent and teacher Metacognitive Index (MI) and Behavior Regulation Index (BRI) of the Behavior Rating Inventory of Executive Function (BRIEF), Executive Function (EF), Developmental Social Disorders (DSD) content scales and Study Skills (StS) and Learning Problems-Teacher Form (LP) of the BASC-2, and Social Skills (SS) and Academic Competence (AC) scales of the SSIS? It was hypothesized that results the BRIEF, SSIS, and BASC-2 scales would be interrelated with strongest correlations between scales measuring the same constructs, or core goal (see Table 1). Using Fall 2013 and Spring 2014, correlational analyses by teacher altnd parent report were conducted (see Tables 3 and 4).

Self-Regulation. For the goal of Self-Regulation, the correlations between the BRIEF BRI - BASC-2 EF were of importance. As can be seen from the tables, for the teacher ratings, the intercorrelation (Pearson *r*) of these two variables was strong and positive, ranging from .49 ($p<.001$; Fall) to .41 ($p<.001$; Spring). Notably, in the Fall, while the correlation of BASC-2 EF is highest with the BRIEF BRI, the correlation of the BRIEF BRI is highest with the BRIEF MI ($r=.65$, $p<.001$). For Spring, the BRIEF BRI –BASC-2 EF is comparable to the BRIEF-BRI – BRIEF MI correlation ($r=.67$; $p<.001$). Similarly, for the parent ratings, the intercorrelation of these two variables was strong and positive, ranging from .83 ($p<.001$; Fall) to .91 ($p<.001$; Spring). For both Fall and Spring, intercorrelations are strongest for the BRIEF-BRI and BASC-2 EF for the parent ratings. At the same time, other intercorrelations are positive and strong as well. These results would not support the use of a single score to represent self-regulation, but rather consideration of subscales.

Executive Function. For the goal of Executive Function, the correlations between the BRIEF MI and the BASC-2 Study Skills from the teacher rating scales was analyzed. As can be seen from Table 3, there was a moderate negative relationship between these variables in both Fall 2013 and Spring 2014. For the teacher ratings, the intercorrelation of these two variables ranges from -.32 (p<.001; Fall) to -.33 (p<.001; Spring).The negative correlation reflects the scoring of the different measures with a high score indicative of deficits on one scale and strengths on the other. As noted already, there was strong positive correlation between BRIEF MI and BRIEF BRI. Given these results, the subscales need to be considered separately. There is no possible comparison for the parent ratings given that the BASC-2 parent form does not have a Study Skills scale.

Social Development. For the goal of Social Development, the correlations between the SSIS SS and BASC-2 DSD were of importance. As can be seen from Table 4, for the teacher ratings, the intercorrelation (Pearson r) of these two variables was a very strong negative correlation, ranging from -.77 (p<.001; Fall) to -.83 (p<.001; Spring). The negative correlation reflects the scoring of the different measures with a high score indicative of deficits on one scale and strengths on the other. Notably, in the Fall, while the correlation of SSIS SS is highest with the BASC-2 DSD, the correlation of the BASC-2 DSD is also very strong and negative for the BASC-2 StS (r=-.74, p<.001). For Spring, the BASC-2 DSD – BASC-2 StS correlation is again a very strong negative correlation (r=-.83; p<.001). Notably, in the Spring, the SSIS SS - BASC-2 StS is also very strong and negative (r=-.71; p<.001).

Table 3
Correlational Analyses (Pearson r) by Teacher Subscale

	BASC-2 EF (n=96)	BASC-2 StS (n=96)	BASC-2 DSD (n=96)	BASC-2 LP (n=96)	BRIEF BRI (n=85)	BRIEF MI (n=85)	SSIS SS (n=96)	SSIS AC (n=96)
BASC-2 EF	-	-.31*	.32*	.37**	**.49****	.23	-.41**	-.01
BASC-2 StS	-.32*	-	-.74**	-.62**	.02	**-.32****	.56**	.46**
BASC-2 DSD	.36**	-.77**	-	.53**	.08	.16	**-.77****	-.34*
BASC-2 LP	.26	-.50**	.47**	-	.11	.46**	-.33*	**-.57****
BRIEF BRI	**.41****	-.43**	.37*	.22	-	.65**	-.15	.03
BRIEF MI	.65**	**-.33****	.39**	.60**	.67**	-	-.09	-.26*
SSIS SS	-.46**	.71**	**-.83****	-.30*	-.27	-.39**	-	-.27*
SSIS AC	-.02	.40**	-.27*	**-.53****	-.38**	-.19	.28*	-

Note. Fall 2013 (above the diagonal) and Spring 2014 (below the diagonal). BRIEF= Behavior Rating Inventory of Executive Function; BASC-2= Behavior Assessment System for Children, Second Edition; SSIS = Social Skills Improvement System; BRI= Behavior Regulation Index; MI= Metacognition Index; SS= Social Skills; AC= Academic Competence; EF= Executive Function; DSD= Developmental Social Disorders. *p<.01; **p<.001

Table 4
Correlational Analyses (Pearson r) by Parent Subscale

	BASC-2 EF (n=96)	BASC-2 DSD (n=96)	BRIEF BRI (n=85)	BRIEF MI (n=85)	SSIS SS (n=96)
BASC-2 EF	-	.58**	**.83****	59**	-.60**
BASC-2 DSD	.70**	-	.50*	.35	**-.73****
BRIEF BRI	.91**	.69**	-	.63**	-.74**
BRIEF MI	.86**	.62**	.86**	-	-.68**
SSIS SS	-.68**	-.79**	-.76**	-.76**	-

Note. Fall 2013 (above the diagonal) and Spring 2014 (below the diagonal). *p<.01; **p<.001

Similarly, for the parent ratings (see Table 5), the intercorrelation of these two variables was very strong and negative, ranging from -.73 (p<.001; Fall) to -.79 (p<.001; Spring). For both Fall and Spring, intercorrelations are strongest for these intercorrelations for the parent ratings. At the same time, the intercorrelations of the SSIS SS with the BRIEF BRI and MI are comparable. These results would not support the use of a single score to represent self-regulation, but rather consideration of subscales.

Academic Competence. For the goal of Social Development, the correlations between the SSIS AC and BASC-2 LP were of importance. As can be seen from Table 4, for the teacher ratings, the intercorrelation (Pearson r) of these two variables was strong and negative, ranging from -.57 (p<.001; Fall) to -.53 (p<.001; Spring). The negative correlation reflects the scoring of the different measures with a high score indicative of deficits on one scale and strengths on the other. Notably, in the Fall, while the correlation of SSIS AC is highest with the BASC-2 LP, the correlation of the BASC-2 LP is also very strong and negative for the BASC-2 StS (r=-.62, p<.001). For Spring, the BASC-2 LP – BASC-2 StS correlation is again a strong negative correlation (r=-.50; p<.001). Parent ratings do not include the BASC-2 LP, so no further analyses on this goal were conducted. As with other goals, it was decided to use the subscales in further analysis.

Parent-Teacher Agreement. It was hypothesized that parent and teachers ratings would be moderately correlated by scale. Correlational analysis was used to examine the relationship between the Parent data on the BASC-2, BRIEF, and SSIS (see Table 5.

The most consistency in parent and teacher ratings were found for the BRIEF BRI and MI subscales for both Fall and Spring (*r*'s ranged from .50 to .70). Interestingly, although strong positive correlations were found for the BASC-2 EF and DSD scales in the Fall, the level of agreement by parent and teacher decreased for the Spring ratings. Parent ratings did not demonstrate as much change across time periods in comparison to teacher ratings. The level of agreement for parent and teacher ratings on the SSIS SS was weak in the Fall (*r*=.26), but more aligned in the Spring 2014 time point than at the Fall 2013 time point (*r*= .56).

Table 5
Correlational Analyses between Teacher and Parent for 2013-2014

	Fall 2013 (n=84)	*Spring 2014 (n=78)*
BASC-2 EF	.64**	.39
BASC-2 DSD	.53**	.39
BRIEF MI	.51*	.50*
BRIEF BRI	.68**	.70**
SSIS SS	.26	.56**

Note. BRIEF= Behavior Rating Inventory of Executive Function; BASC-2= Behavior Assessment System for Children, Second Edition; SSIS = Social Skills Improvement System; BRI= Behavior Regulation Index; MI= Metacognition Index; SS= Social Skills; EF= Executive Function; DSD= Developmental Social Disorders. *p<.01; **p<.001

Research Question: Effects of Time. To what extent do parent and teacher ratings of Metacognitive Index, Behavior Regulation Index (BRIEF), Executive Function and Social Developmental Disorder content scales (BASC-2), and Social Skills and Academic Competence scales (SSIS) vary across time points? It is hypothesized that teacher and parent ratings will vary across time points for all measures. Correlational

analyses (Pearson's r) will be used to examine the relationship between the measures across time points, including parent and teacher report. To investigate intervention effects and how students vary across time points, multivariate analysis of covariance (MANCOVA) was used to analyze between group means with years at TMS as a covariate. Each variable was examined separately.

For the BASC-2 Study Skills, two time points were entered for this analysis (*n=75*). MANCOVA, covarying for years and level, was significant for the program level [*F* (1, 72) =25.52; *p*<.001; partial eta-squared= .26] but not the numbers of years at TMS [*F* (1, 72) =1.03; *p*=.32; partial eta-squared= .01]. See Table 6.

Table 6
Covariance of Independent Variable- BASC-2 Study Skills

	Type III Sum of Squares	***df***	***Mean Square***	***F***	***Sig.(p)***	***Partial Eta Squared***
Corrected Model	1496.14	2	748.07	20.64	<.001	.36
Intercept	22345.53	1	22345.53	616.38	<.001	.90
Years	37.15	1	37.15	1.03	.32	.01
Level	925.88	1	925.88	25.54	<.001	.26
Error	2610.21	72	36.25			
Total	111875.00	75				
Corrected Total	4106.35	74				
R Squared = .36 (Adjusted R Squared = .35)						

For the BASC-2 Executive Function, two time points were entered for this analysis (*n*=75). MANCOVA, covarying for years and level, was significant for the

number of years at TMS [F (1, 72) =18.15; p<.001; partial eta-squared= .20] but not the program level [F (1, 72) =1.15; p=.29; partial eta-squared= .02]. See Table 7.

Table 7
Covariance of Independent Variable- BASC-2 EF

	Type III Sum of Squares	***df***	***Mean Square***	***F***	***Sig. (p)***	***Partial Eta Squared***
Corrected Model	1551.84	2	775.92	9.73	<.001	.21
Intercept	90794.96	1	90794.96	1138.16	<.001	.94
Years	1447.89	1	1447.89	18.15	<.001	.20
Level	91.58	1	91.58	1.15	.29	.02
Error	5743.68	72	79.77			
Total	344775.00	75				
Corrected Total	7295.52	74				
R Squared = .21 (Adjusted R Squared = .19)						

For the BASC-2 Developmental Social Disorders, two time points were entered for this analysis (n=75). MANCOVA, covarying for years and level, was significant for the program level [F (1, 72) =17.10; p<.001; partial eta-squared= .19] but not the number of years at TMS [F (1, 72) =1.57; p=.21; partial eta-squared= .02]. See Table 8.

For the BASC-2 Learning Problems, two time points were entered for this analysis (n=75). MANCOVA, covarying for years and level, was not significant for the program level [F (1, 72) =2.05; p=.16; partial eta-squared= .03] or the number of years at TMS [F (1, 72) =.09; p=.77; partial eta-squared= .00]. See Table 9.

For the BRIEF Behavior Regulation Index, two time points were entered for this analysis (n=75). MANCOVA, covarying for years and level, was significant for the

numbers of years at TMS [F (1, 72) =10.36; p<.001; partial eta-squared= .13] but not the program level [F (1, 72) =4.77; p=.03; partial eta-squared= .06]. See Table 10.

Table 8
Covariance of Independent Variable- BASC-2 DSD

	Type III Sum of Squares	***df***	***Mean Square***	***F***	***Sig. (p)***	***Partial Eta Squared***
Corrected Model	2857.84	2	1428.92	15.52	<.001	.30
Intercept	69242.18	1	69242.18	751.86	<.001	.91
Years	144.69	1	144.69	1.57	.21	.02
Level	1575.19	1	1575.19	17.10	<.001	.19
Error	6630.83	72	92.10			
Total	317970.00	75				
Corrected Total	9488.67	74				
R Squared = .30 (Adjusted R Squared = .28)						

Table 9
Covariance of Independent Variable- BASC-2 LP

	Type III Sum of Squares	***df***	***Mean Square***	***F***	***Sig. (p)***	***Partial Eta Squared***
Corrected Model	460.87	2	230.44	1.67	.20	.04
Intercept	62955.01	1	62955.01	455.93	<.001	.86
Years	12.19	1	12.19	.09	.77	.00
Level	282.92	1	282.92	2.05	.16	.03
Error	9941.80	72	138.08			
Total	301811.00	75				
Corrected Total	10402.67	74				
R Squared = .04 (Adjusted R Squared = .02)						

For the BRIEF Metacognitive Index, two time points were entered for this analysis (*n*=75). MANCOVA, covarying for years and level, was not significant for the program level [*F* (1, 72) =3.32; *p*=.07; partial eta-squared= .04] or the number of years at TMS [*F* (1, 72) =2.04; *p*=.16; partial eta-squared= .03]. See Table 11.

Table 10
Covariance of Independent Variable- BRIEF BRI

	Type III Sum of Squares	***df***	***Mean Square***	***F***	***Sig. (p)***	***Partial Eta Squared***
Corrected Model	2516.46	2	1258.23	5.43	.01	.13
Intercept	129508.52	1	129508.52	558.89	<.001	.89
Years	2399.44	1	2399.44	10.36	<.001	.13
Level	1105.44	1	1105.44	4.77	.03	.06
Error	16684.20	72	231.73			
Total	485697.00	75				
Corrected Total	19200.67	74				
R Squared = .13 (Adjusted R Squared = .11)						

Table 11
Covariance of Independent Variable- BRIEF MI

	Type III Sum of Squares	***df***	***Mean Square***	***F***	***Sig. (p)***	***Partial Eta Squared***
Corrected Model	719.07	2	359.54	1.85	.16	.05
Intercept	104612.99	1	104612.99	539.25	<.001	.88
Years	395.09	1	395.09	2.04	.16	.03
Level	644.55	1	644.55	3.32	.07	.04
Error	13967.81	72	193.99			
Total	448343.00	75				
Corrected Total	14686.88	74				
R Squared = .05 (Adjusted R Squared = .02)						

For the SSIS Social Skills, two time points were entered for this analysis (n=75). MANCOVA was completed, covarying for years and level, was not significant for the program level [F (1, 72) =7.78; p=.01; partial eta-squared= .10] or the number of years at TMS [F (1, 72) =4.54; p=.04; partial eta-squared= .06]. See Table 12.

Table 12
Covariance of Independent Variable- SSIS SS

	Type III Sum of Squares	***df***	***Mean Square***	***F***	***Sig. (p)***	***Partial Eta Squared***
Corrected Model	4614.02	2	2307.01	11.84	<.001	.25
Intercept	92162.82	1	92162.82	472.85	<.001	.87
Years	884.03	1	884.03	4.54	.04	.06
Level	1516.65	1	1516.65	7.78	.01	.10
Error	14033.37	72	194.91			
Total	512506.00	75				
Corrected Total	18647.39	74				
R Squared = .25 (Adjusted R Squared = .23)						

Table 13
Covariance of Independent Variable- SSIS AC

	Type III Sum of Squares	***df***	***Mean Square***	***F***	***Sig. (p)***	***Partial Eta Squared***
Corrected Model	404.15	2	202.07	.64	.53	.02
Intercept	128920.53	1	128920.53	407.99	<.001	.85
Years	17.65	1	17.65	.06	.81	.00
Level	369.61	1	369.61	1.17	.28	.02
Error	22751.14	72	315.99			
Total	608717.00	75				
Corrected Total	23155.28	74				
R Squared = .02 (Adjusted R Squared = -.01)						

For the SSIS Academic Competence, two time points were entered for this analysis (n=75). MANCOVA, covarying for years and level, was not significant for the program level [F (1, 72) =1.17; p=.28; partial eta-squared= .02] or the number of years at TMS [F (1, 72) =.06; p=.81; partial eta-squared= .00]. See Table 13.

Research Question: TMS Levels. Do the students at differing levels (Novice/Apprentice, Challenger/Voyager) differ on current measures of functioning across measures representing the four core goals and outcomes? It is hypothesized that children will differ significantly by level in terms of behavioral regulation, metacognitive skills, social interaction skills, and academic competence, as well as executive function and social development. Specifically, it was hypothesized that children in the Novice/Apprentice level would evidence more deficits in core domains as compared to those in the Voyager/Challenger level. Time point Spring 2014 was used for this analysis as that time point included the largest number of subjects. MANCOVA of independent variables was significant for program level [F (13, 60) =5.30; p<.001; partial eta-squared= .53] but not the number of years at TMS [F (13, 60)=1.96; p=.04; partial eta-squared= .30]. The program level has a greater effect size on the independent variables than the number of years in TMS program. Of the independent variables, BASC-2 Study Skills (Teacher), BASC-2 DSD (Teacher and Parent), and SSIS SS (Teacher and Parent) were significantly different (p<.01). See Table 14 for univariate results.

MANCOVA was completed for each outcome measure. For the BASC-2 BSI, two time points were entered for this analysis (n=71). MANCOVA, covarying for years

and level, was significant for the number of years at TMS [F (1, 68) =33.50; p<.001; partial eta-squared= .33] but not the program level [F (1, 68) =.73; p=.40; partial eta-squared= .01]. See Table 15.

Table 14
Univariate Results by Level (Means and Standard Deviations), Spring 2014

	Novice/Apprentice n=44 M (SD)	***Challenger/Voyager n=31 M (SD)***	***Partial Eta Squared***
BRIEF BRI			
Teacher	77.82 (14.15)	80.36 (18.68)	
Parent	64.71 (9.15)	67.81 (15.54)	
BRIEF MI			
Teacher	74.30 (12.77)	78.52 (15.65)	
Parent	63.93 (8.17)	66.61 (11.57)	
BASC-2 EF			
Teacher	68.07 (8.77)	65.68 (11.38)	
Parent	59.91 (7.61)	63.10 (13.12)	
BASC-2 DSD			
Teacher	69.18 (8.99)	56.97 (10.48)	.27
Parent	71.27 (10.04)	62.19 (11.60)	.15
BASC-2 StS			
Teacher	34.21 (5.45)	43.16 (6.75)	.36
BASC-2 LP			
Teacher	64.39 (13.30)	59.42 (8.84)	
SSIS SS			
Teacher	75.23 (14.38)	89.55 (14.17)	.20
Parent	74.66 (14.18)	84.94 (14.84)	.11
SSIS AC			
Teacher	86.46 (17.49)	91.07 (17.90)	

Note. BRIEF= Behavior Rating Inventory of Executive Function; BASC-2= Behavior Assessment System for Children, Second Edition; SSIS = Social Skills Improvement System; BRI= Behavior Regulation Index; MI= Metacognition Index; SS= Social Skills; AC= Academic Competence; EF= Executive Function; DSD= Developmental Social Disorders; StS= Study Skills; LP=Learning Problems.

For the BASC-2 Adaptive Skills, two time points were entered for this analysis (*n*=71). MANCOVA, covarying for years and level, was not significant for the number of years at TMS [*F* (1, 68) =5.61; *p*=.02; partial eta-squared= .08] or the program level [*F* (1, 68) =1.40; *p*=.24; partial eta-squared= .02]. See Table 16.

Table 15
Covariance of Outcome Variable- BASC-2 BSI

	Type III Sum of Squares	***df***	***Mean Square***	***F***	***Sig. (p)***	***Partial Eta Squared***
Corrected Model	3791.29	2	1895.65	22.48	<.001	.40
Intercept	111306.74	1	111306.74	1319.91	<.001	.95
Years	2825.34	1	2825.34	33.50	<.001	.33
Level	61.59	1	61.59	.73	.40	.01
Error	5734.37	68	84.33			
Total	342333.00	71				
Corrected Total	9525.66	70				
R Squared = .40 (Adjusted R Squared = .38)						

Table 16
Covariance of Outcome Variable- BASC-2 AS

	Type III Sum of Squares	***df***	***Mean Square***	***F***	***Sig. (p)***	***Partial Eta Squared***
Corrected Model	578.82	2	289.41	5.42	.01	.14
Intercept	24046.05	1	24046.05	450.53	<.001	.87
Years	299.21	1	299.21	5.61	.02	.08
Level	74.59	1	74.59	1.40	.24	.02
Error	3629.38	68	53.37			
Total	125618.00	71				
Corrected Total	4208.20	70				
R Squared = .14 (Adjusted R Squared = .11)						

For the GRADE, two time points were entered for this analysis (n=71). MANCOVA, covarying for years and level, was not significant for the number of years at TMS [F (1, 68) =.03; p=.86; partial eta-squared= .00] or the program level [F (1, 68) =1.73; p=.19; partial eta-squared= .03]. See Table 17.

Table 17
Covariance of Outcome Variable- GRADE

	Type III Sum of Squares	***df***	***Mean Square***	***F***	***Sig. (p)***	***Partial Eta Squared***
Corrected Model	436.12	2	218.06	.94	.40	.03
Intercept	159848.20	1	159848.20	685.69	<.001	.91
Years	6.95	1	6.95	.03	.86	.00
Level	404.03	1	404.03	1.73	.19	.03
Error	15852.27	68	233.12			
Total	673700.00	71				
Corrected Total	16288.39	70				
R Squared = ..03 (Adjusted R Squared = -.00)						

Table 18
Covariance of Outcome Variable- GMADE

	Type III Sum of Squares	***df***	***Mean Square***	***F***	***Sig. (p)***	***Partial Eta Squared***
Corrected Model	362.21	2	181.10	.80	.46	.02
Intercept	131694.29	1	131694.29	578.68	<.001	.90
Years	156.44	1	156.44	.69	.41	.01
Level	69.21	1	69.21	.30	.58	.00
Error	15475.34	68	227.58			
Total	595085.00	71				
Corrected Total	15837.55	70				
R Squared = .02 (Adjusted R Squared = -.01)						

For the GMADE, two time points were entered for this analysis (n=71). MANCOVA, covarying for years and level, was significant for the number of years at TMS [F (1, 68) =.69; p=.41; partial eta-squared= .01] but not the program level [F (1, 68) =.30; p=.58; partial eta-squared= .00]. See Table 18.

Research Question: Relation to Outcome Measures. For the 2013-2014 data, which of the components as measured by the Teacher BRIEF, BASC-2, and SSIS (i.e., metacognition, behavior regulation, executive functioning, social skills, academic competence, social development) account for significant variance in academic achievement as measured by the Group Mathematics Assessment and Diagnostic Evaluation (GMADE) and Group Reading Assessment and Diagnostic Evaluation (GRADE)? Which components account for significant variance in emotional/behavioral adjustment as measured by the BASC-2 Behavior Symptom Index (BSI) and Adaptive Skills (AS) Composite? It is hypothesized that the Metacognition Index (MI) and the Study Skills (StS) Scale will account for the greatest variance in academic achievement as measured by the GMADE and GRADE. It is hypothesized that the Behavioral Regulation Index (BRI) and Executive Function (EF) Content Scale will account for the greatest variance in emotional and behavioral adjustment as measured by the BASC-2 BSI and Adaptive Skills (AS) Composite.

Regression analyses were completed to determine how well the independent variables predict the outcome variables. For the BASC-2 BSI, the model was found to explain a significant amount of the variance in the BASC-2 BSI [F (8, 73)=52.46, p < .001; R2 = .85]. The analysis shows that the BASC-2 EF [*Beta* =.43, t(81)= 6.13,

p<.001], BASC-2 DSD [*Beta* =.50, *t*(81)= 5.20, *p*<.001], and BRIEF BRI [*Beta* = .28, *t*(81) = 3.36, *p*<.001] significantly predict the BASC-2 BSI. See Table 19.

Table 19
Regression Table- Spring 2014, BASC-2 BSI

	B	***Beta***	***t***	***p***	***95% Confidence Interval***
(Constant)	-8.76		-.80	.43	(-30.66 - 13.13)
BASC-2 EF	.46	.43	6.13	<.001	(.31 - .61)
BASC-2 StS	.06	.04	.61	.55	(-.14 - .27)
BASC-2 DSD	.47	.50	5.20	<.001	(.29 - .65)
BASC-2 LP	.01	.01	.12	.90	(-.13 - .14)
BRIEF BRI	.18	.28	3.36	<.001	(.07 - .29)
BRIEF MI	.01	.01	.08	.94	(-.11 - .12)
SSIS SS	.01	.02	.23	.82	(-.10 - .13)
SSIS AC	.00	-.00	-.01	.99	(-.07 - .07)
R2	.85				
F	52.46				

Note. BRIEF= Behavior Rating Inventory of Executive Function; BASC-2= Behavior Assessment System for Children, Second Edition; SSIS = Social Skills Improvement System; BRI= Behavior Regulation Index; MI= Metacognition Index; SS= Social Skills; AC= Academic Competence; EF= Executive Function; StS= Study Skills; LP= Learning Problems; DSD= Developmental Social Disorders.

For the BASC-2 Adaptive Skills (AS), the model was found to explain a significant amount of the variance in the BASC-2 AS [*F* (8, 73)=11.36, *p* < .001, R2 = .56]. The analysis shows that the BRIEF BRI [*Beta* = -.60, *t*(81) = -4.17, *p*<.001] significantly predicts the BASC-2 AS. See Table 20.

For the GRADE, the model was found to explain a significant amount of the variance in the GRADE [*F* (8, 55)=3.747, *p*=.001, R2 = .35]. The analysis shows that the

SSIS AC [*Beta* = .44, *t*(63) = 3.11, *p*<.001] significantly predicts the GRADE. See Table 21.

Table 20
Regression Table- Spring 2014, BASC-2 AS

	B	***Beta***	***t***	***p***	***95% Confidence Interval***
(Constant)	58.04		4.22	<.001	(30.65 – 85.43)
BASC-2 EF	.06	.07	0.61	.54	(-.13 - .24)
BASC-2 StS	.18	.18	1.43	.16	(-.07 - .44)
BASC-2 DSD	-.24	-.35	-2.10	.04	(-.46 - -.01)
BASC-2 LP	-.04	-.06	-.49	.63	(-.21 - .13)
BRIEF BRI	-.28	-.60	-4.17	<.001	(-.42 - -.15)
BRIEF MI	.19	.36	2.58	.01	(.04 - .33)
SSIS SS	.04	.09	.60	.55	(-.10 - .18)
SSIS AC	-.08	-.19	-1.74	.09	(-.17 - .01)
R2	.56				
F	11.36				

Table 21
Regression Table- Spring 2014, GRADE

	B	***Beta***	***t***	***p***	***95% Confidence Interval***
(Constant)	71.51		1.84	.07	(-6.24 – 149.26)
BASC-2 EF	.27	.19	1.09	.28	(-.22 - .76)
BASC-2 StS	.44	.21	1.29	.20	(-.24 – 1.12)
BASC-2 DSD	-.29	-.21	-1.02	.31	(-.85 - .28)
BASC-2 LP	-.15	-.11	-.63	.53	(-.62 - .32)
BRIEF BRI	-.19	-.23	-1.01	.32	(-.57 - .19)
BRIEF MI	.25	.25	1.29	.20	(-.14 - .65)
SSIS SS	-.27	-.27	-1.45	.15	(-.65 - .10)
SSIS AC	.38	.44	3.11	<.001	(.14 - .63)
R2	.35				
F	3.75				

For the GMADE, the model was not found to explain a significant amount of the variance in the GMADE [F (8, 58)=.80, p=.61, R2 = .10]. The analysis shows that no independent variables significantly predict GMADE. See Table 22.

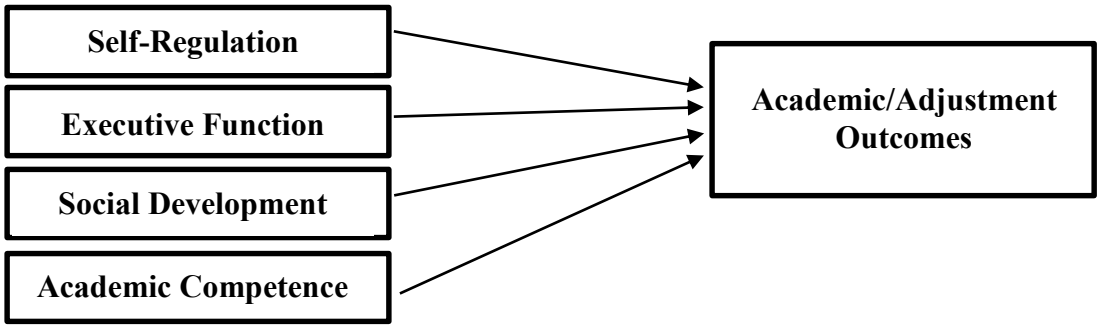
Table 22
Regression Table- Spring 2014, GMADE

	B	***Beta***	***t***	***p***	***95% Confidence Interval***
(Constant)	102.90		2.06	.04	(3.02 – 202.78)
BASC-2 EF	.19	.13	0.64	.52	(-.41 - .80)
BASC-2 StS	-.08	-.04	-0.19	.85	(-.94 – .78)
BASC-2 DSD	.01	.01	.02	.98	(-.72 - .73)
BASC-2 LP	-.52	-.36	-1.72	.09	(-1.12 - .08)
BRIEF BRI	-.22	-.24	-.99	.32	(-.66 - .22)
BRIEF MI	.26	.24	1.09	.28	(-.22 - .74)
SSIS SS	.03	.02	.11	.91	(-.46 - .51)
SSIS AC	.06	.15	.37	.72	(-.25 - .36)
R2	.10				
F	.80				

Research Question: Concurrent and Predictive Validity. Is academic achievement predicted better by the results of the BRIEF, BASC-2, and SSIS completed concurrently or can achievement be predicted by scores on these measures from earlier years (i.e., results from 1-2 years before)? Are concurrent or earlier scores predictive of emotional and behavioral outcomes? It is hypothesized that outcome variables for academic achievement and emotional/behavioral outcomes are better predicted by concurrent results as opposed to earlier results. Multiple regression analysis will be used

with the BRIEF, BASC-2, and SSIS variables at the earliest point available as predictors and GRADE, GMADE, and BASC-2 scales as outcomes (See Figure 2).

Figure 2. Regression Model for TMS.



For the BASC-2 BSI, the model was not found to explain a significant amount of the variance in the BASC-2 BSI [F (4, 20)=.407, p=.80, R2 = .08]. The analysis shows that none of the independent variables significantly predicted the BASC-2 BSI. See Table 23.

For the BASC-2 Adaptive Skills (AS), the model was not found to explain a significant amount of the variance in the BASC-2 AS [F (4, 21)=1.79, p= .17, R2 = .26]. The analysis shows that none of the independent variables significantly predicted the BASC-2 AS. See Table 24.

For the GRADE, the model was not found to explain a significant amount of the variance in the GRADE [F (4, 13)=2.81, p=.07, R2 = .46]. The analysis shows that none of the independent variables significantly predict GRADE. See Table 25.

Table 23
Regression Table, Predictive Data 2012- BASC-2 BSI

	B	*Beta*	*t*	*p*	*95% Confidence Interval*
Constant	76.70		3.81	<.001	(34.67 – 118.72)
BRIEF BRI	.13	.26	.57	.56	(-.35 - .61)
BRIEF MI	-.08	-.15	-.33	.74	(-.55 - .40)
SSIS SS	-.11	-.18	-.73	.48	(-.40 - .20)
SSIS AC	.00	.00	.01	.99	(-.35 - .35)
R^2	.08				
F	.41				

Note. BRIEF= Behavior Rating Inventory of Executive Function; BASC-2= Behavior Assessment System for Children, Second Edition; SSIS = Social Skills Improvement System; BRI= Behavior Regulation Index; MI= Metacognition Index; SS= Social Skills; AC= Academic Competence; BSI= Behavior Symptoms Index.

Table 24
Regression Table, Predictive Data 2012- BASC-2 AS

	B	*Beta*	*t*	*p*	*95% Confidence Interval*
Constant	14.18		.96	.35	(-16.52 – 44.87)
BRIEF BRI	-.28	-.68	-1.74	.10	(-.61 - .05)
BRIEF MI	.35	.87	2.12	.05	(.01 - .69)
SSIS SS	.12	.24	1.16	.26	(-.09 - .33)
SSIS AC	.12	.24	1.06	.30	(-.11 - .35)
R^2	.26				
F	1.79				

For the GMADE, the model was not found to explain a significant amount of the variance in the GMADE [F (4, 17)=.89, p=.49, R2 = .17]. The analysis shows that none of the independent variables significantly predicted GMADE. Thus, results indicate that for all outcome variables, results are better predicted concurrently rather than several years earlier. See Table 26.

Table 25
Regression Table, Predictive Data 2012- GRADE

	B	*Beta*	*t*	*p*	*95% Confidence Interval*
Constant	60.89		1.11	.29	(-57.27 – 179.04)
BRIEF BRI	.61	.73	1.55	.14	(-.24 – 1.46)
BRIEF MI	-.82	-.95	-2.01	.07	(-1.70 - .06)
SSIS SS	.33	.29	1.05	.32	(-.35 – 1.01)
SSIS AC	.21	.18	.68	.51	(-.46 - .88)
R^2	.46				
F	2.81				

Table 26
Regression Table, Predictive Data 2012- GMADE

	B	*Beta*	*t*	*p*	*95% Confidence Interval*
Constant	69.43		.91	.38	(-92.10 – 230.95)
BRIEF BRI	.72	.66	1.36	.19	(-.40 – 1.85)
BRIEF MI	-.78	-.73	-1.58	.13	(-1.81 - .26)
SSIS SS	.55	.35	1.15	.27	(-.46 – 1.57)
SSIS AC	-.23	-.17	-.61	.55	(-1.01 - .56)
R^2	.17				
F	.89				

CHAPTER V

CONCLUSIONS

The purpose of this study was to gather information about long-term outcomes from systematic interventions that may assist children with neurodevelopmental disorders to develop in the area of executive functioning. It was designed to provide insight on the effectiveness of the combination of approaches in facilitating EF development, in predicting academic or social outcome, and the usefulness of the measures currently used for program monitoring. There are gaps in the literature related to investigating social, academic, and emotional/behavioral outcomes over several years from exposure to a systematic intervention in a therapeutic day school for children with EF deficits, often found in children with ASD and ADHD.

Core Goal Correlations

The present study addressed several research questions. The first question investigated the relationships between the measures used to represent the four core goals (self-regulation, executive function, social development, academic competence) at the Monarch School. It was hypothesized that results would be interrelated, with strongest correlations between scales measuring the same constructs, or core goal. It was also hypothesized that parent and teacher ratings would be moderately correlated by scale.

In terms of the four core goals, intercorrelations were often strongest for the measures representing the core component, however, the measures were often strongly correlated with other measures suggesting that these results would not support the use of

a single score to represent a core goal, but rather consideration of subscales. This finding may be due to the strong association of scales within specific measures (e.g., BRIEF BRI and BRIEF MI). The study findings did suggest that as expected, teacher and parent ratings were moderately correlated across scales except for Fall 2013 SSIS-SS reports.

Effects of Time

The second research question inquired about the extent to which parent and teacher ratings of independent variables vary across time points. It is hypothesized that teacher and parent ratings would vary across time points for all measures. Study findings did support that teacher and parent ratings did vary across time points for all independent measures. This is consistent with the literature, suggesting that these measures do demonstrate sensitivity to systematic interventions over time (McClendon, Warren, Green, Burlingame, Eggett, & McClendon, 2011).

Additionally, the MANCOVA analyses also looked at the impact of program level and the number of years at TMS over time. Findings suggested that for measures associated with self-regulation, BASC-2 EF and BRIEF BRI, the number of years at TMS accounted for significant variance over time. In terms of social development, the program level accounted for significant variance on the BASC-2 DSD over time. Lastly, on the BASC-2 StS, the program level account for significant variance over time.

TMS Levels

This study also sought to investigate whether students at separate program levels (Novice/Apprentice, Challenger/Voyager) differ on current measures of functioning

across measures representing the four core goals and outcomes. It was hypothesized that children will differ significantly by level in terms of behavioral regulation, metacognitive skills, social interaction skills, and academic competence, as well as executive function and social development. Specifically, it was hypothesized that children in the Novice/Apprentice level would evidence more deficits in core domains as compared to those in the Voyager/Challenger level. Study results suggest that overall, the program level accounted for more variance than years in the program.

Additionally, the BASC-2 DSD and SSIS SS, the measures of social development and interaction skills were significantly different for the Challenger/Voyager level than the Novice/Apprentice level. This suggests that the children in the Novice/Apprentice level demonstrate more deficits in the social development domain than those children in the Challenger/Voyager domain. This is consistent with the literature that suggests that students with less developed executive functioning skills often demonstrate significant deficits in the areas of social communication and social interaction (Carrington, Templeton, and Papinczak, 2003). Furthermore, participants differed significantly across levels on the BASC-2 StS, such that children in the Challenger/Voyager level demonstrated more academic readiness and study skills that may likely impact their general school functioning. Consistent with the literature, students who have difficulty forming and maintaining social interactions with peers, parents, and teachers typically also show impairments in academic skills and academic achievement (Russo et al., 2007; Verte et al., 2006).

Relation to Outcome Measures

The present study also looked at which of the core components account for significant variance in emotional/behavioral adjustment and academic achievement. It was hypothesized that the MI and the StS scales would account for the greatest variance in academic achievement as measured by the GMADE and GRADE. It was hypothesized that the BRI and EF scales would account for the greatest variance in emotional and behavioral adjustment as measured by the BASC-2 BSI and BASC-2 AS. Results of the regression analyses did indicate the BRIEF BRI and BASC-2 EF scales did account for significant variance on the BASC-2 BSI, as did the BASC-2 DSD. On the BASC-AS, only the BRIEF BRI accounted for significant variance. These results are generally consistent with the literature that behavioral regulation and executive functioning impact long-term outcomes related to behavioral and emotional adjustment (Mayo, Chlebowski, Fein, & Eigsti, 2013; Szatmari et al., 2006). In terms of academic achievement, SSIS AC accounted for significant variance on the GRADE but not the GMADE. None of the independent variables accounted for significant variance on the GMADE.

Concurrent and Predictive Validity

Finally, this study also investigated whether academic achievement and emotional/behavioral adjustment are better predicted by the measures completed concurrently and examined whether achievement can be predicted by scores on these measures from earlier years (i.e., results from 1-2 years before). It was hypothesized that outcome variables for academic achievement and emotional/behavioral outcomes

are better predicted by concurrent results as opposed to earlier results. The study findings suggested that academic achievement and emotional/behavioral adjustment are better predicted concurrently. In fact, the study results indicated that none of the independent variables (earlier ratings) accounted for significant variance on any of the outcome measures.

Limitations and Future Research

The present study is an attempt to extend the research examining executive function and school-based intervention programs as well as exploring the association between executive function and academic, social, and emotional/behavioral functioning. Results from this study should be interpreted with regard to the study limitations. First, this study was conducted with a small sample and this may have resulted in between group differences that may exist but were not evident. As a result of the sample size, power was negatively impacted. Given the literature and the clinical nature of the sample, a small sample size is not surprising, as it is difficult to recruit a sufficient amount of participants given the specified criteria. Nevertheless, future research should focus on recruiting more participants in order to increase statistical power, possibly using a multi-site approach. Furthermore, larger sample sizes would allow researchers to determine whether specific characteristics (e.g., gender, years in the program, level, diagnosis, etc.) influence this association between executive function and long-term outcomes for children with neurodevelopmental disorders. Moreover, the results of this study cannot be generalized beyond this sample and its characteristics. It is important to note that this was a sample of convenience in that only volunteers were included and the

study was limited geographically. This sample was rather homogeneous, as all participants were recruited from the same therapeutic day school in Houston, TX. It should not be generalized without appropriate caution and future research should be conducted to examine these associations in other cultural samples.

Additionally, the other area of limitation in this study is the measure and method of investigating executive function and related long-term outcomes. Specifically, only observer rated instruments were used for independent variable constructs and most of the outcome variables. In terms of the academic measures, additional research is needed to support the use of the measures in future research studies. The use of additional measures, such as observations, cognitive testing, or neuropsychological assessment, may have introduced different task demands that may have detected additional deficits. Further, additional research related to executive functioning, with a full range of emotional and behavioral functioning, educational outcomes, and social well-being may be beneficial.

Given the limited number of participants and predetermined group associations, this study was not able to assign children to appropriate level groups based on present levels of functioning or adequately compare differences in associations between the children classified across different levels at the Monarch School. Future research is needed to examine the differences between children with distinct profiles of executive functioning as it relates to social, academic, and emotional/behavioral development.

Lastly, this study used one theory of executive function. As described earlier, there is no clear consensus in the literature on the definition of executive function

(Varney & Stewart, 2004). Although the abilities measured in this study are similar to those noted in other theories and research studies, a different construct definition may better encompass the complexities of executive function abilities. This study was limited to the definition of executive function as defined by the Monarch School and its core program components. Research on the relationship between executive function and long-term outcomes for children should continue to reflect and stay up to date with the empirical understanding of the construct of executive function.

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